THE

ELECTRICAL REVIEW.

VOL. LIII. AUGUST 21, 1903. No. 1,343.

"ELECTRICAL REVIEW."

Vol. LIII.] CONTENTS: August 21, 1903. [No. 1,343.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1903 Edition

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THE DISASTER AT PARIS.

PROBABLY no occurrence of recent years has caused a more acute sensation of horror and alarm than the lamentable disaster which took place last week on the Metropolitan Electric Railway of Paris. Unfortunately, we may say with equal truth that no event within our memory has given rise to such a prodigious amount of solemn twaddle in the columns of the daily Press, with the result that the London electric railways have experienced a distinct falling-off in their traffic returns. That this will be of but a temporary nature is certain, for the public soon forget, and in a few weeks the normal condition will be practically restored; in the meantime, every time a circuit-breaker on one of the motor-cars comes out with its usual pop-gun report, there is a paragraph in the papers describing the alarming explosion at so-and-so station, and the success of the heroic officials in extinguishing the imaginary fire.

The devices which have been suggested to remove the dangers of travel in "tubes" are legion, and are for the most part hopelessly ineffective and absurd, or based upon a total misunderstanding of the circumstances. In point of fact, we are convinced that in this instance—we say it with regret—the fault lay mainly with the management. It is known that the fire broke out in the first instance in the open air; instead of completely extinguishing the flames there, they were hastily put out, probably only partially, and the train proceeded into the tunnel. The rapid motion naturally fanned the smouldering fire into renewed activity, but still the blazing train, pushed by a second, was allowed to proceed, until, as might and should have been expected, a complete breakdown took place. Even then there might have been no more serious result than the stoppage of traffic; but the crowning error lay in permitting a loaded train to approach the scene of the breakdown—actually to within 300 metres! Had the train been stopped even at the station before the Gare des Couronnes, no harm would have followed. Finally, the passengers, unable to appreciate the imminence of the danger, appear to have lingered on the platform demanding the return of their fares, until the choking clouds of smoke, accompanied by the extinction of the lights, brought destruction upon them—*in the station*, be it noted, *not in the tunnel*.

Apart from the deplorable errors of management which we have pointed out, and which, we hope and believe, could never find a parallel on British railways, the lessons of the disaster seem to us to be concentred in those two factors—*smoke and darkness*. It was not by fire that the victims perished, but by suffocation; and had they not lost their way in the darkness, crowding towards a dead wall where there was no exit, the majority of them might well have escaped. The moral, therefore, to be marked by the managers of our electric railways is—avoid the use of inflammable materials to the utmost, and provide adequate

lighting, totally independent of the generating station and of the cables through the tunnel.

Non-flammable wood, uralite, sheet steel, &c., must figure largely in the construction of the carriages, and, if possible, even the wooden sleepers might be replaced by steel.

We are not of those who foresee in our tube railways the probability of such a disaster as that which has taken place in Paris. Apart from the fact that elaborate precautions have already been taken to prevent the possibility of fire, and to provide independent lighting, it must be borne in mind that for thirteen years the City and South London Electric Railway has kept a wholly clean sheet, while the Metropolitan Railway has run for 40 years, and the District for 35, without a fire. The latter lines, it will be noticed, like the Paris Metropolitan, have wide tunnels containing both up and down lines, whereas the "tubes" have separate tunnels. Curiously enough, Mr. J. A. Baker, who is humorously styled "the engineer of the London County Council" in the *Daily Telegraph*, elaborately contrasted the Paris tunnels with the shallow tramways proposed by the L.C.C., apparently unaware that the Paris railway partakes far more of the nature of the shallow tramway than of the "Tubes"!

The fact that the tunnels are separate appears to constitute an element of safety, for if by chance a fire should occur in one tunnel, it is not probable that the adjoining tunnel would become untenable on account of the smoke for a considerable period, so that passengers who could escape to a station would be practically safe. The suggestion that the fan at Shepherd's Bush could be of the slightest use in case of fire, although it has been put forward as a safeguard, is, of course, mere dust throwing.

Mr. C. T. Yerkes has come forward as an authority on the subject of electric railway working, a position to which he is entitled only on the strength of his own opinion and that of the *Daily Mail*, which attacked the Central London Railway with a totally uncalled-for degree of animosity. Mr. Yerkes thinks that American engineers have had far more experience of the subject than British engineers; as a matter of fact, while we have had an underground electric railway for 13 years, which has worked with unvarying success, there is not a single line of a similar character in America. Moreover, our experience of overhead electric railway working is almost as lengthy; it is certainly longer than that of any American. Mr. Yerkes himself has as yet had no experience whatever in connection with underground electric traction, and his observations are well calculated to do more damage to his own projects than to the tube railways now at work; for the District Railway also has wooden platforms, to which he rightly objects, to say nothing of wooden stairs, wooden signal boxes, wooden sleepers, and wooden rolling stock. Moreover, the tunnel is of similar character to that of the Paris Metropolitan, save in its greater size and more substantial construction. Unless, therefore, Mr. Yerkes takes his own advice, which is certainly sound, the railways under his control will remain the most dangerous in London.

However, while we think that every possible precaution should be taken with a view to rendering a fire impossible, we repeat that in our opinion the probability of such a disaster on our railways is exceedingly remote, and we have every confidence in their continued successful operation.

Foreign and British Engineering.

THE *Engineer*, in discussing British and Foreign engineering, calls attention to the extreme simplicity of the former, and the complexity of the latter. It can, of course, make little or no difference whether a locomotive is called on to draw a train in this country or across the narrow seas which separate us from the European Continent. Yet how different are the machines which are set to do the same duties. A British locomotive is a machine of so simple a character that it possesses no superfluous parts. Every object aimed at is attained by the use of few parts. A foreign locomotive, on the contrary, is, as one engineer playfully expressed it, a most indecent machine, with all its vitals hung outside, and an altogether unnecessary complication of valve gearing. The same applies to stationary engine work. Anyone who visited Paris in 1900, must have noticed the many curious and complicated valve gears and other details of the engines there exhibited. This complication in design applies, not only to steam engineering, but to other things also, and it appears to be distinctive of the foreign designer as opposed to the direct methods of English work. In the matter of machine design, American practice has aimed rather at British than at foreign methods, and apart from it, less weight and less attention given to durability. American practice is British rather than European. As our contemporary remarks, the use of a number of pieces to secure a given end, say in a mechanical movement, has no terrors to the foreign draughtsman. The aim seems to be at a sort of academic perfection of movement. To us it savours a good deal of a divorce between the shops and the offices. The relative positions are those of the officer and private in the the army. As a well known American resident of Berlin once wrote—"Every German seeks to attain that position whence he can look down upon his former friends and associates." With this spirit animating the officials there is little wonder if office designs are carried out in every crudity of multifarious and excessive detail. A complicated valve gear does nothing to promote economy of steam. A highly finished engine interior, as regards the internal cover and piston surfaces may be beneficial, but this is quite a different matter. Small surfaces, small clearances and steam tightness, combined with good drainage or superheat to prevent wetness are the points essential to economy. These various matters are closely connected with the whole question of technical education. Are Continental designs of machines the outcome of a superior technical education? If they are, then such technical education is not the sort of thing that we require. We may be slow to move in fresh directions, but when we do move it is usually to some purpose, nor do we stop until we have accomplished something, and what we do is usually well done, durable and practical.

It is said that the German firm who so light-heartedly undertook to supply locomotives to India have found that they cannot easily meet the rigid inspection to which English builders are accustomed. The foreign work was not of the sound quality called for by the Indian railway officials, and there was considerable rejection of faulty parts. We are not short of technical men of the highest order, but we are too much governed by non-technical men in commanding positions whose aim appears to be to try to get along without technical men. To grudge payment for engineering guidance is the most suicidal policy of any industrial undertaking, and it would not happen if principals and managers were themselves technically educated along sound practical lines.

ELECTRICITY IN MINES.

By T. CAMPBELL FUTERS.

Probably no branch of applied electricity has provoked more interest or discussion as to the relative advantages and dangers of its application, than that of the use of electricity in mines, as witness the recent Home Office inquiry. The reason is not far to seek, as in no other industry is the transmission of power so absolutely necessary, by some means or other, and electrical driving so suitable.

A vast amount of capital is laid out in the various power plants at the collieries of Great Britain, and hence the need for the most efficient means of transmitting power, which has undoubtedly proved to be electrical. Its application is not one so full of difficulties and dangers as some people would have us believe, though the question is still in an unsettled state. The reason why it has not been more extensively adapted is due, to a great extent, to the position of the colliery manager, who is hedged in by the "Coal Mines Regulation Act," on the one hand, and the necessity of keeping down capital expenditure on the other, and principally because a colliery manager must, under the "Act," be a mining engineer, mechanical engineer, and now an electrical engineer, or, as the old saw has it, "A Jack of all trades and master of none"; It is impossible to expect a colliery manager to have the technical knowledge and experience in mechanical or electrical engineering which takes years of practice and study to acquire, and at the same time to have that knowledge and experience in mining engineering, which in itself requires a training of no less duration, and in the result electricity—which was not understood—has been looked upon with doubt and suspicion, until it was proved that by its adoption money would be saved. Electrical engineers, on the other hand, were largely ignorant of mining conditions, but recognising the opening for electrical appliances, were keenly competing with each other.

Thus a number of schemes and tenders have been placed in the hands of the colliery manager, who was utterly unable to express any opinion as to the merits or demerits of the several tenders, and in the end accepted the lowest—good or bad. There was thus a great element of chance, depending on the standing and thoroughness of the electrical firm, as the work would be carried out with little or no supervision, and no doubt many of the accidents and much of the blundering which has occurred is due entirely to carelessness and ignorance, which might have been avoided with careful supervision, better design and workmanship, even though this would have entailed more expense at the beginning.

It is one thing to build and run a motor with a steady load in a works or factory, but quite another thing in a colliery. The profit earned by a colliery depends upon the output; the greater the output, the less the cost per ton of fixed charges, and consequently it is of vital importance to first ensure that the machinery upon which the output depends, shall be well able to do its work without risk of breakdown. This is the *first* consideration, efficiency being only second, and it applies to all colliery machinery, as the component engines and machines depend on each other, and the stoppage of one may stop the whole. A fused wire on an electric underground hauling plant, may stop a whole district from producing coals, the loss so caused probably amounting to enough to buy the plant two or three times over. A breakdown of a pump may mean serious stoppage (and consequently loss) of all or part of a mine! Everything depends upon being kept "going"—no matter "how," but "kept going." This will probably account for so much of the machinery at collieries not giving that efficiency which the up-to-date engineer expects, and so often drawing the remark "that colliery people set no value on fuel, as they get it for nothing." Contrary to this impression, colliery engineers are fully alive to the necessity of economical working, but the machinery must be well able to do its work. It pays better in the long run to put in an engine 20 per cent. over its load than $\frac{1}{20}$th per cent. under it. It will not be quite so efficient, but there is less chance of breakdown.

In this connection there is another point of much more importance, and that is, *safety* or freedom from danger to life and limb; to ensure this requires the most careful supervision and daily examination of all machinery, a breakdown to which might result in an injury or fatality to a workman.

The first application of electricity was that of signalling, which took the place of the "rapper," consisting of a hammer—worked by a wire, lever and bell crank—striking an iron plate, which become ponderous affairs when the distance is great. Many, however, are still in use as electric signalling, in spite of improvements, is still in many points defective, due principally, however, to cheap material and bad workmanship.

Considerable trouble was experienced by the writer owing to certain shaft wires breaking, which were lead-covered and fastened to the shaft buntons with staples, and he finally put in a "multiple wire" cable, thoroughly insulated, and armoured with galvanised iron wires, which is freely suspended in the shaft from a beam at the surface (see fig. 1). The wires are led through stuffing boxes into watertight junction boxes, placed in convenient positions, with brass terminals mounted upon a slate base, and from there to the various bells and pushes as required.

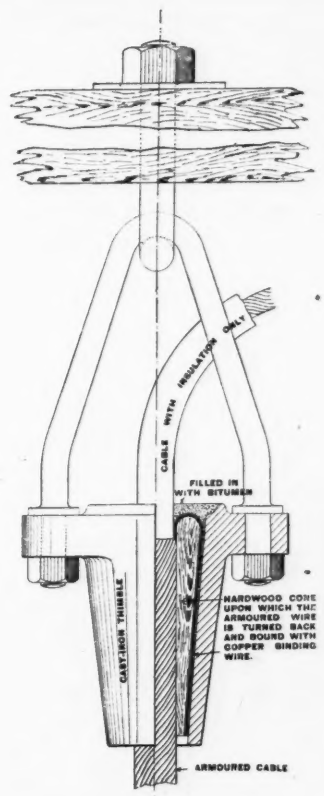

CABLE WITH INSULATION ONLY
FILLED IN WITH BITUMEN
CAST-IRON THIMBLE
HARDWOOD CORE UPON WHICH THE ARMOURED WIRE IS TURNED BACK AND BOUND WITH COPPER BINDING WIRE.
ARMOURED CABLE

Fig. 1

Underground bell circuits usually consist of bare iron wire, on insulators attached to the timbering or roof-plugs. This is necessary, as it is usually required to ring from any point on the engine plane or hauling road, and when not interfered with gives little trouble; the chief difficulty being corrosion in wet places. Some pit-water will even corrode copper wire, and in one instance this difficulty could only be overcome by keeping that part of the line "greased."

Bells, relays and pushes should be strongly made and enclosed in watertight cases, so that they cannot be interfered with, and there is still room for an improved "push," the chief difficulty being the failure of the plunger and spring. Léclanche cells are generally used, but a great improvement would be effected by using secondary batteries, where there are facilities for recharging. Much more attention should

be given to good workmanship and quality of material, for in mine signalling especially, the cheapest is often the dearest —very many times over.

Electricity is now generally utilised for lighting at collieries, for the surface at any rate, and in many cases at the shaft bottom. Incandescent lighting is usually employed, though greater economy and better lighting would result from a greater use of arc lamps. With incandescent lighting there need be no question of danger, even at the bottom of the upcast shaft of a fiery mine.

It is, however, in the transmission of power that electricity finds a large and useful field for application. The great objection to its adoption is the risk of a spark from a motor brush, or an arc due to a cable breaking, causing an explosion; and to remove this objection various ideas have been put forward.

That it is possible to fire an explosive mixture with a spark from a motor brush is not disputed, and it did not need any elaborate experiments to prove it; but why should there be an explosive mixture? Further, why should a motor spark badly enough to fire it? and lastly, why should a cable break?

The normal condition of any mine is that there should be sufficient ventilation to render the air as pure as possible, and in a fiery mine there must be enough air passing around the working places to enable the workmen to stay their shift of six or eight hours without any ill effects, and in such an atmosphere it would be impossible for an *enclosed* continuous-current motor to cause an explosion; and, moreover, an explosive mixture would first show on a safety lamp, and if it remained, it would be necessary for the workmen to withdraw, and the machine would in consequence cease working.

Too much has been said about the motor sparking and too little about efficient ventilation. The way to prevent risk of explosion is to ensure sufficient air to dilute and carry away any gas which may be given off.

(To be continued.)

TESTS ON BROKEN CABLES— SOME INCONSISTENCIES IN LOCALISATION FORMULÆ.

NOTE BY E. RAYMOND-BARKER.

(*Concluded from page* 251.)

LOCALISATION FORMULÆ SYNOPSIS WITH UNIFORM NOMENCLATURE.

Here follows an *aperçu* of various localisation methods based on one uniform nomenclature as used by the writer, who ventures to submit the same to colleagues in the electrical profession. Examples, in themselves affording corroborative proof of the formulæ in question, have been taken from actual tests through 2003·8 ohms (ctd.) to cable core with copper exposure for 48 hours immersed in sea-water.

Bridge ratio = 1,000 : 1,000. Currents noted on 2nd galvanometer shunted to 1^{ω} res. approx.

TESTS TO S.Z.

Br. Rdg. $R_1 = 2{,}049{\cdot}7^{\omega}$ when current $c_3 = 17{\cdot}32$ m.a.
" " $R_2 = 2{,}078{\cdot}6^{\omega}$ " " $c_2 = 8{\cdot}417$ m.a.
" " $R_3 = 2{,}128^{\omega}$ " " $c_1 = 4{\cdot}127$ m.a.

TESTS TO F.Z.

Br. Rdg. $R_1 = 2{,}029^{\omega}$ when current $c_3 = 17{\cdot}21$ m.a.
" " $R_2 = 2{,}040{\cdot}3^{\omega}$ " " $c_2 = 8{\cdot}366$ m.a.
" " $R_3 = 2{,}055{\cdot}6^{\omega}$ " " $c_1 = 4{\cdot}085$ m.a.

The index figures here pertaining to R and c indicate the progressive values of R and c. The higher the resistance, or the higher the current, the higher the index. Thus, in a triple test, the strongest current c_3 produces the lowest Br. Rdg. R_1. Conversely the lowest current c_1 produces the highest Br. Rdg. R_3. Adherence to this systematic nomenclature is calculated to prevent misunderstanding.

EXAMPLES.

Kempe Formula for Kennelly Dual Test to F.Z.

$$x = \frac{R_1\sqrt{c_2} - R_2\sqrt{c_1}}{\sqrt{c_2} - \sqrt{c_1}},$$

where $R_1 = 2{,}029^{\omega}$ with c_2 of 17·21 m.a.
$R_2 = 2{,}055{\cdot}6^{\omega}$ with c_1 of 4 085 m.a.

$$x = \frac{2{,}029\sqrt{17{\cdot}21} - 2{,}055{\cdot}6\sqrt{4{\cdot}085}}{\sqrt{17{\cdot}21} - \sqrt{4{\cdot}085}} = 2{,}003{\cdot}7 \text{ ohms.}$$

(A) *Simplified Kennelly.—F.Z.*

$R_1 = 2{,}029^{\omega}$ with c_2 of 17·21 m.a.
$R_2 = 2{,}055{\cdot}6^{\omega}$ with c_1 of 4·085 m.a.

$$x = R_1 - \left[(R_2 - R_1)\frac{1}{\sqrt{\frac{c_2}{c_1}} - 1}\right].$$

$$x = 2{,}029 - \left[(2{,}055{\cdot}6 - 2{,}029)\frac{1}{\sqrt{\frac{17{\cdot}21}{4{\cdot}085}} - 1}\right]$$

= 2,003·7 ohms.

(B) *Simplified Kennelly.— F.Z.*

$R_1 = 2{,}029^{\omega}$ with c_2 of 17·21 m.a.
$R_2 = 2{,}055{\cdot}6^{\omega}$ with c_1 of 4·085 m.a.

$$x = R_2 - \left[(R_2 - R_1)\frac{\sqrt{\frac{c_2}{c_1}}}{\sqrt{\frac{c_2}{c_1}} - 1}\right]$$

$$x = 2{,}055{\cdot}6 - \left[(2{,}055{\cdot}6 - 2{,}029)\frac{\sqrt{\frac{17{\cdot}21}{4{\cdot}085}}}{\sqrt{\frac{17{\cdot}21}{4{\cdot}085}} - 1}\right]$$

= 2,003·7 ohms.

(C) *Simplified Kennelly.—F.Z.*

$R_1 = 2{,}029^{\omega}$ with c_2 of 17·21 m.a.
$R_2 = 2{,}055{\cdot}6^{\omega}$ with c_1 of 4·085 m.a.

$$x = \frac{R_1 - \left(R_2\sqrt{\frac{c_1}{c_2}}\right)}{1 - \sqrt{\frac{c_1}{c_2}}}.$$

$$x = \frac{2{,}029 - \left(2{,}055{\cdot}6 \times \sqrt{\frac{4{\cdot}085}{17{\cdot}21}}\right)}{1 - \sqrt{\frac{4{\cdot}085}{17{\cdot}21}}} = 2{,}003{\cdot}7 \text{ ohms.}$$

Dual Test when Currents 4 : 1.—F.Z.

c_2 of 17·21 m.a. gave $R_1 = 2{,}029^{\omega}$.
c_1 of 4·085 m.a. gave $R_2 = 2{,}055{\cdot}6^{\omega}$.

$x = R_1 - (R_2 - R_1) = 2{,}029 - (2{,}055{\cdot}6 - 2{,}029)$
$= 2{,}002{\cdot}4$ ohms.

$x = 2R_1 - R_2 = (2 \times 2{,}029) - 2{,}055{\cdot}6 = 2{,}002{\cdot}4$ ohms.

Cann's Correction for Ratio when Currents not exactly 4 : 1.

In present case ratio is $\frac{17{\cdot}21}{4{\cdot}085} : 1 = 4{\cdot}213 : 1 - \text{F.Z.}$

(In use since 1895.)

$R_1 = 2{,}029^{\omega}$ obtained when $d_2 = 526{\cdot}5$ divs.
$R_2 = 2{,}055{\cdot}6^{\omega}$ " " $d_1 = 125$ "

where d_1 and d_2 = deflections on second galvanometer used as milliampere-meter, or on the single galvanometer used in a direct reproduction test. In the latter case d_1 and d_2 would be corrected for E.C.

$$x = R_1 - \left[(R_2 - R_1)\,4\,\frac{d_1}{d_2}\right]$$

$$x = 2{,}029 - \left[(2{,}055{\cdot}6 - 2{,}029)\ 4\ \frac{125}{526{\cdot}5}\right] = 2{,}003{\cdot}7 \text{ ohms.}$$

Darby and Fisher Method for Correcting the Result of a Dual 4 : 1 Ratio Test when Ratio not exactly 4 : 1.

If no extra galvanometer is available to be used as a milliamperemeter, to eliminate the effect on calculations of any earth current that may be present, a supplementary test is made to S.Z.

Example :—With testing batteries of 40 and 10 Leclanché cells respectively of 20^{ω} and 5^{ω} total internal res., also $59{\cdot}4^{v}$ and $14{\cdot}85^{v}$ total E.M.F. Bridge ratio = 1,000 : 1,000.

BRIDGE READINGS :—

Using 40 cells $R_1 = 2{,}029$ } To F.Z.
„ 10 „ $R_2 = 2{,}055{\cdot}6$ }
„ 40 „ $r_1 = 2{,}049{\cdot}7$ } To S.Z.
„ 10 „ $r_2 = 2{,}128$ }

In case of r_1, current flowing to cable—

$$= \frac{59{\cdot}4}{1{,}000 + 2{,}049{\cdot}7 + (2 \times 20)} = 0{\cdot}019225 = 19{\cdot}225 \text{ m.a.}$$

In case of r_2, current flowing to cable—

$$= \frac{14{\cdot}85}{1{,}000 + 2{,}128 + (2 \times 5)} = 0{\cdot}00473 = 4{\cdot}7324 \text{ m.a.}$$

$$\text{Ratio} = \frac{19{\cdot}225}{4{\cdot}7324} = 4{\cdot}0625$$

$$x = \frac{R_1 \sqrt{4{\cdot}0625} - R_2}{\sqrt{4{\cdot}0625} - 1}$$

$$x = \frac{2.029 \sqrt{4{\cdot}0625} - 2{,}055{\cdot}6}{\sqrt{4{\cdot}0625} - 1} = 2{,}002{\cdot}7 \text{ ohms.}$$

Cann's Triple Test with Currents in Ratio of 4 : 2 : 1.—S.Z.

c_3 of 17·32 m.a. gave R_1 of $2{,}049{\cdot}7^{\omega}$.
c_2 of 8·417 m.a. „ R_2 of $2{,}078{\cdot}6^{\omega}$.
c_1 of 4·127 m.a. „ R_3 of 2,128.

$x = R_1 + R_2 - R_3 = 2{,}049{\cdot}7 + 2{,}078{\cdot}6 - 2{,}128 = 2{,}000{\cdot}3$ ohms (approx.).
Ratio not exactly 4 : 2 : 1.

Rymer-Jones's Dual Test (Modification of Cann's).—S.Z.

c_2 of 8·417 m.a. gave R_1 of 2,078·6 ohms.
c_1 of 4·127 m.a. gave R_2 of 2,128 „

$$x = 2{\cdot}5576\ R_1 - 1{\cdot}5576\ R_2.$$

$x = (2{\cdot}5576 \times 2{,}078{\cdot}6) - (1{\cdot}5576 \times 2{,}128) = 2{,}001{\cdot}7$ ohms.
(Not corrected.) *

Darby and Fisher's Triple Test, Based on Kennelly Law, Using any Currents.—S.Z.

$R_1 = 2{,}049{\cdot}7^{\omega}$ with $c_3 = 17{\cdot}32$ m.a. $r_3 = 4{\cdot}1968$.
$R_2 = 2{,}078{\cdot}6^{\omega}$ „ $c_2 = 8{\cdot}417$ m.a. $r_2 = 2{\cdot}0395$.
$R_3 = 2{,}128^{\omega}$ „ $c_1 = 4{\cdot}127$ m.a. $r_1 = 1$.

$$x = \frac{(r_3 . R_1 - R_2)(\sqrt{r_2} - 1) - (r_3 . R_2 - R_3)(\sqrt{r_3} - 1)}{(r_3 - 1)(\sqrt{r_2} - 1) - (r_2 - 1)(\sqrt{r_3} - 1)}.$$

$$x = \frac{[(4{\cdot}1968 \times 2.049\,7 - 2.128)(\sqrt{2{\cdot}0395} - 1)] - [(4{\cdot}1968 - 1)(\sqrt{2{\cdot}0395} - 1)] - [(2\,0395 \times 2{,}078{\cdot}6 - (2{,}128)(\sqrt{4{\cdot}1968} - 1)]}{[2{\cdot}0395 - 1)(\sqrt{4{\cdot}1968} - 1)]}.$$

$$x = 2{,}002{\cdot}1 \text{ ohms.}$$

Kennelly Test, Three Measurements.—S.Z.
Currents in Proportion 1 : 4 : 9.

R_1 = Lowest res. with highest current in proportion 9.
R_2 = Intermediate res. with intermediate current in proportion 4.
R_3 = Highest res. with lowest current in proportion 1.

$$x = \frac{R_3 + R_1}{2} - 4\ (R_2 - R_1).$$

Kennelly Test, Three Measurements, S.Z.
Currents in Proportion 1 : 4 : 16.

R_1 = Lowest res. with current : proportion 16.
R_2 = Intermediate res. with current : proportion 4.
R_3 = Highest res. with current : proportion 1.

$$x = \frac{R_3 + 2\ R_1}{3} - 2\ (R_2 - R_1).$$

N.B.—Kennelly has pointed out that this test is not limited to 25 milliamperes.

Triple Test by John McGill, Three Measurements, F.Z.
Currents in Proportion 1 : 2 : 4.

R_1 = Lowest res. with highest current : proportion 4.
R_2 = Intermediate res. with intermediate current : proportion 2.
R_3 = Highest res. with lowest current : proportion 1.

When R_2 and R_3 are measured, artificial res. is added to battery circuit equivalent to difference between internal res. of cells in use, and that of battery in use for R_1.

$$x = R_2 - 4{\cdot}75\ (R_2 - R_1).$$

Simplified Schaefer Formula (1) S.Z.

$$x = R_1 - [(R_2 - R_1)K] \mp \left[\left(\frac{e}{c_1} - \frac{e}{c_2}\right) K - \frac{e}{c_1}\right]$$

where c_2 = the higher current in *amperes* producing the lower resistance R_1.
„ c_1 = the lower current in *amperes* producing the higher resistance R_2.
„ e = E.M.F. of E.C. in volts for calculation of correction to be either additive or subtractive, according as it is in same or opposite direction to that of the testing current.
„ $n = \frac{c_2}{c_1}$.
„ $K = \frac{1}{\sqrt[1\cdot3]{n-1}}$.

Simplified Schaefer Formula (2) S.Z.

$$x = R_2 - [(R_2 - R_1)k] \mp \left[\left(\frac{e}{c_1} - \frac{e}{c_2}\right) k - \frac{e}{c_1}\right]$$

where c_2 = higher current in amps. producing lower res. R_1.
c_1 = lower current in amps. producing higher res. R_2.
e = E.M.F. of E.C. in volts for correction + or −, according as E.C. is in same or opposite direction to that of testing current.

$$k = \frac{\sqrt[1\cdot3]{n}}{\sqrt[1\cdot3]{n-1}}, \qquad n = \frac{c_2}{c_1}.$$

The foregoing summary of break localisation methods reduced to uniform nomenclature may prove acceptable to members of cable staffs who have not had the advantage—enjoyed by some of their elder colleagues—of watching *ab initio* the gradual evolution of exact methods in tests to cable breaks.

The work of Sir Henry C. Mance gave that impetus to original research among cable men, which led up to the enunciation, by the present Dr. A. E. Kennelly, of his law that the resistance to earth of the exposed copper at a fault or break in a cable, varies inversely as the square root of the current passing when this does not exceed 25 milliamperes.

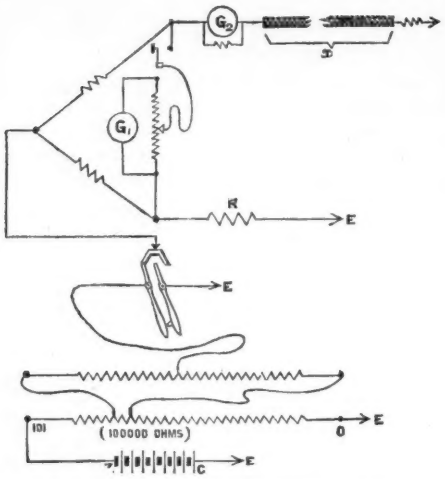
Other well-known names have, from time to time, contributed further data, the present accumulation of which tends somewhat to confuse the mind of the young aspirant confronted, on his first initiation, by a variety of books and nomenclatures, not to speak of occasional apparent contradictions in formulæ.

A word, in conclusion, may be devoted to a device by the writer, to the best of his knowledge not mentioned elsewhere. Where a set of high-resistance Kelvin-Varley slides stand handy, as is the case in most testing rooms, this apparatus may be used for adjusting to a nicety the various currents required to flow to line when tests are made on a faulty or broken cable.

* See *Kempe*, 6th edition, p. 283, in which appear printer's errors :—"5 per cent." and "30 per cent." instead of 5^{ω}, 30^{ω}.

NOTE.—The above Cann and Rymer-Jones's results would have agreed more absolutely with true value 2,003·8 ohms had the current ratios been exactly 4 : 2 : 1 and 2 : 1 respectively. These examples are not specimen tests, but are given merely with reference to nomenclature.

In an actual example of a test—one of a series—on a broken cable, current powers to line were adjusted by slides to give on G_2 (or milli-ammeter) 310, 155, and 77·5 divs., severally representing 11·92, 5·96, and 2·98 *m. a.* Corresponding scale-zero bridge balances on G_1 were 1,869, 1,882, 1,905 ohms. The mean—1847·3$^{\omega}$—of two almost similar results calculated from these data, was subsequently found to be correct within 2 ohms.



CONNECTIONS WITH KELVIN-VARLEY SLIDES.

No reference has here been made to the interesting work done by Mr. E. Jona in curve methods of localisation, some graphic examples of which may be given on a future occasion.

TANGENTIAL TRACTION.

A NEW system of electric traction, called "tangential traction," has been invented by two young Russian engineers, Messrs. Rosenfeld and Zelenais, and has been worked out and made practicable with the assiduous and intelligent assistance of M. Julien Dulait, manager of the Electricity and Hydraulic Co., of Charleroi. Six years have elapsed since the inventors conceived this idea, but detailed reports of the experiments have not been published until now. Two years ago, it is true, some learned societies in Belgium witnessed the first trials, but these only served to demonstrate the practical possibility of the proposed solution of the problem.

On May 25th last, at the invitation of M. Dulait, about 250 members of the Société Belge d'Electriciens and the Société Belge d'Ingénieurs et Industriels, conducted by M. Léon Gérard, manager of the Société de Traction Electrique sur les Voies Navigables, and President of the Société Belge d'Electriciens, and M. Du Fourni, Engineer-in-Chief of Roads and Bridges, and President of the Société Belge d'Ingénieurs et Industriels, went to Charleroi, where the visitors, piloted by M. Dulait and his engineers, among whom were included the inventors, Messrs. Rosenfeld and Zelenais, visited the workshops of the Société Electricité et Hydraulique. At noon a luncheon was provided for the visitors by M. Dulait, at the Bourse. After lunch M. Du Fourni made a speech in which, after having thanked M. Dulait, he announced that the Committee appointed to award the prize of 15,000 fr. offered by Galileo Ferraris —who, we may remark, by his discovery of the revolving field, rendered possible the invention of tangential traction —had judged that, out of the 27 competitors, Messrs. Dulait, Rosenfeld and Zelenais were most entitled to the prize. This decision had been arrived at after a visit paid to the installation of tangential traction by the delegates of the Committee, among whom was Prof. Grassi, the successor of Galileo Ferraris at the Electrical Institute of Turin.

M. Léon then spoke in the name of the "Société Belge d'Electriciens," after which M. Dulait thanked those present, and described the new system.

Tangential traction is based upon the direct application of polyphase currents. The most characteristic feature of the system is the entire absence of the rotating motor in the car, and of any connection between the vehicle and the source of electrical energy. The movement of the car is effected by the utilisation of a magnetic field for propulsion in either direction, the working of which may be described as follows:—

We know that in polyphase motors generally, there is no electrical connection between the revolving part, which is called the rotor, and the fixed part called the stator. In consequence of the combination of the polyphase currents sent into the stator, a revolving magnetic field is produced, which, by means of the reactions produced in the rotor, draws the latter with it and imparts to it a rotary motion. If we develop along a plane surface the field magnet of such a motor and suspend over it at a suitable distance its armature similarly developed, the rotary motion will be transformed into a rectilinear motion. This being granted, let us consider a vehicle placed on two rails; we will fix between the rails the developed field magnet, called the *stator*, and suspend under the vehicle, above the stator, the developed armature, called the *propeller;* this vehicle will be put in motion when a polyphase current is sent into the fixed part of the system—*i.e.*, into the stator. Under these conditions the magnetic field no longer revolves, but travels along. This principle, however simple and seductive it may appear, says M. Dulait, can never be applied practically as long as we keep to the arrangements generally adopted for polyphase motors.*

In the design of ordinary polyphase motors, in order to obtain efficiency and economy in construction, we are obliged to reduce as much as possible the air-gap—that is, the free space between the rotor and the stator. This air-gap may sometimes be no more than the fraction of a millimetre.

Of course, in industrial applications of tangential traction, with such a distance between the stator and the propeller, it would be quite impossible to obtain any regular working of the system. The inventors have therefore been compelled to seek for a different arrangement, enabling the air-gap to be increased.

Generally speaking, to increase the air-gap without changing the magnetic reluctance, we must increase the metallic surfaces that face one another. Let us suppose, for example, that for a given surface of the poles we have an air-gap of 1 millimetre. In order to have an air-gap of three times this thickness, while retaining the same reluctance, we shall merely have to treble the size of the opposite surfaces. Now, with the ordinary mode of construction of polyphase motors, this increase of surface could only be obtained by increasing the width of the iron cores. The winding of the copper in the slots would evidently become proportionately longer, and if it had the same section as before, the efficiency of the motor would be diminished.

If, on the other hand, we increase the section so as to have the same efficiency, we must increase the dimensions of the slots. Magnetic leakage then increases very rapidly, and the practical construction of such a motor becomes impossible.

In any case, the enlargement of the air-gap means an increase in the quantity of copper, which, as in the case under consideration, may become prohibitive.

To meet this difficulty the inventors have had recourse to the following expedient. Instead of enlarging the whole of the core, they enlarge it at the poles by means of pieces of sheet-iron laid transversely, the core itself being laminated longitudinally. By this method, the winding round the core retains its original length, and the surface of the air-gap can be increased to the extent required.

In order to test the efficacy of these polar extensions, the inventors have inverted the problem, *i.e.*, they have con-

* In passing we may call attention to the system devised by Prof. Perry at about the same period, in which the primary winding of a transformer, with a laminated iron core, is laid in the track, while the secondary winding, also provided with an iron core, is carried on the car, and the polar faces of the stationary and moving cores are brought as close together as possible. The secondary winding was to be connected with a motor to drive the car. Unfortunately the preliminary experiments showed that the cost of laying and working the system was likely to be prohibitive. Single-phase alternating currents alone were used, so far as we are aware.—EDS. ELEC. REV.

structed a rotary asynchronous motor, the stator of which is fitted with polar extensions. This motor, of 100 H.P., had an air-gap of 10 millimetres, and during the tests gave results quite comparable with those of motors constructed in the ordinary way, although the quantity of copper used for the winding was even *less* than usual. Before entering upon the construction of the large 100-H.P. motor, Messrs. Dulait, Rosenfeld and Zelenais began by constructing and studying a smaller motor of 15 H.P. of the same type, which gave entirely satisfactory results.

In the explanation of the principle of the system, we have assumed the stator to be fixed all along the track between the two rails, the three-phase current flowing along the whole length of the stator. It is evident that if we are considering a very long track on which trains travel at a considerable distance from one another, the practical and economical realisation of such a system will not be possible. But when making their first calculations for a practical application, the inventors saw that the stator need not extend along the whole of the track; but that, on the contrary, in order to supply the normal tractive effort, it would be sufficient to have stators occupying only a small fraction of the length. Thus the track is provided with blocks of stators placed at regular intervals. This spacing has to be determined for each application, according to the tractive effort required and the length of the propeller. There is a certain relation between these magnitudes that will involve the minimum of cost.

In order that the action of the stators on the propeller may be continuous, notwithstanding their being disconnected, the length of the propeller must be equal to or a little greater than the distance from centre to centre of the stators.

This spacing of the stators solves the problem from the point of view of the first cost of installation; but, except in a few special cases, it fails to meet the question of the expenditure of energy and cost of working. In fact, each stator gives rise to losses of electrical and magnetic energy, and if we have to feed all the stators on the track simultaneously, the sum of these losses will be out of proportion to the work supplied.

In order to reduce these losses to what is strictly unavoidable, Messrs. Dulait, Rosenberg and Zelenais designed the following arrangement, based on the employment of an interrupter of any type suited to the system of distribution and to the voltage used, and worked by a three-phase motor. The working of this arrangement is as follows:—The entire length of the track is divided into sections of suitable length, each containing one or more blocks of stators. All the stators in one section are connected in series; the three wires of the three-phase winding of the first stator in each section are connected with the distributors placed along the track, and the three ends of the last stator winding are connected with the contact blocks of an interrupter. When this interrupter is closed, the three ends of the windings of the stators are connected together, and form the neutral point. The stators are then traversed by the three-phase current. When, on the other hand, the interrupter is open, the neutral point of the three-phase winding of the stators is broken, and the current no longer passes through. In order that a group of stators may be traversed by the current only when the train is passing through this section, the interrupter must close automatically at the moment that the train enters the section in question and open again as soon as the train has left it. This automatic opening and closing of the interrupter may be effected by the following method:—The knife-blade of each interrupter is attached to the rotor of a little three-phase motor, the stator of which is fed by a special circuit and continually traversed by the current.

The rotor of the little motor has an open circuit winding which comprises two phases, two of the extremities of which are connected together, and the two others communicate by two flexible conducting cables with the two rails of the track. The rails of one section are insulated from the rails of another section. We must remark that the circuit of the rotor of the little motor is of very low voltage, and that consequently the insulation of the rails and the sections is insignificant. In fact, practice has shown that no special insulation is necessary. Until a train enters a section, the winding of the rotor of the little motor remains open and its field magnet, although continuously excited by the current, does not exert upon it any appreciable torque. The interrupter attached to the rotor remains open under the action of a counterpoise. But as soon as the first axle of the train comes upon the section, the rotor of the little motor being closed on short circuit by the wheels and the axle of the car, the motor begins to move and closes the interrupter by raising the counterpoise. As long as a train remains upon the section, the rotor keeps the interrupter closed, notwithstanding the counterpoise; but when the last axle of the train leaves the rails of the section, the winding of the rotor is opened again, the action that was exercised by the field-magnet ceases, and the counterpoise, being no longer sustained by the torque of the rotor, opens the interrupter.

Thus, to sum up this description briefly, by means of the above arrangement, the train on entering a section closes the interrupter automatically, the latter opening again automatically when the train leaves the section. Consequently, the stators will only be traversed by the current while the train remains in the section.

While the train is passing from one section to another, there will be a period when two sections of stators will be traversed by the current, in particular when the first axle of the train has entered upon one section, while the last axle has not left the section before. A special combination of automatic interrupters worked by the three-phase motors realises first, a means of reversing the motion of the car itself, which is utilised for the electric brake action by the stators, and second, the block system, which is automatic and absolutely reliable.

(To be continued.)

CARRIAGE OF MERCHANDISE ON ELECTRIC TRAMWAYS.

By THOMAS UPTON,

Goods Traffic Manager to the South Lancashire Tramways and Liverpool and Prescot Light Railway Companies.

(*Continued from page* 253.)

A certain amount of trans-shipment will always be necessary on tramways serving districts not on a continuous line of route, and although a train would consist, say, of two cars only, they would start with goods for various places, lying in different directions, besides putting out and picking up *en route*. Now supposing such a train started from Liverpool for Bolton, it might be found on arrival at Atherton that the goods were principally for Leigh and Lowton, therefore the train would be diverted accordingly, and the few goods for Bolton would have to be trans-shipped to another car. Moreover, from "Spur termini," such as Tyldesley and Lowton, there would probably be some goods for Bolton, but it would not pay to run them through, neither would it be policy to divert a train and delay it considerably for the purpose of picking up the traffic at its starting points; again, it would not do to run a number of wagons through to a given point, such as Bolton, with small loads of perhaps three or four packages or hundredweights. In such cases it certainly becomes necessary to trans-ship goods at a convenient centre, very much after the system adopted by railway companies. Of course this would not apply to full loads, but to groceries, provisions, drapery, and such-like traffic, in which consignments consist of small packages weighing from a few pounds to, possibly, 3 to 5 cwts. each.

To deal with general merchandise, and, for that matter, large consignments in most instances, it becomes necessary to establish depôts at convenient places along the line of route for distribution by carts or other vehicles to the consignees, and to which also the public could convey their merchandise for forwarding to any destination if they felt so inclined. In short, the depôt would have to be worked on exactly similar lines to those adopted for a railway goods depôt.

It need hardly be pointed out that many firms buy their various commodities in bulk, leaving the greater part in the

hands of the carrier to warehouse at fixed charges, and issuing orders to customers for small quantities of the bulk, which the latter would collect themselves, or instruct the carrier to deliver on their behalf. It is, therefore, evident for the extra labour and cartage involved, other charges must be made over and above that originally incurred for freight and delivery. These charges are known as "split" delivery charges, and are a source of much revenue. They are brought about entirely by the *modus operandi* adopted by wholesale dealers and merchants, adding considerably to the cost of conveyance; but they cannot be placed to the account of excessive railway rates.

It may be suggested that much of the present cartage of heavy goods, such as raw cotton, &c., would be done away with by running sidings off the tramways into mills and works; this is quite agreed so far, but who is to bear the cost of such sidings? Surely not the tramway or light railway company. The traders have the benefit of the sidings, obtain cheaper rates by reason of performing the unloading or loading of goods, and are in a position to suit their own purposes, or to order their traffic by other routes and means, if everything were not done exactly to their own ideas and wishes, when the sidings would remain so much dead loss to the tramway or light railway company. It therefore appears to me that the proper course is for the traders who desire sidings into their mills or works to pay the cost of them, and then if they did not wish to handle their traffic by that means, no loss would fall on any person other than themselves. Tramways and light railway companies must follow in the footsteps of the railway companies in these matters, and there is no doubt that firms, when they find it worth their while to go in for sidings, will do so at their own cost.

In connection with this matter, it has been frequently pointed out to the writer by firms, that they would not allow the wagons to enter their yards, provided sidings were laid in, until certain hours; that they would have to be kept back at some convenient place until then; that they could not guarantee to unload the same day or day following; again, that some particular portion of a consignment would probably be wanted immediately and the rest not for some days; that they had no suitable place for storage, and as a consequence would detain the wagons to suit their convenience. By having the goods at a depôt they get exactly what they require of a consignment, leave the rest behind, and the wagons are not delayed, the company unloading to meet their own requirements, while the small charge made for warehousing is cheaper and cannot be considered against the working value of that portion of their own works, which would otherwise have to be utilised for storage purposes.

In regard to many traffics passing in fair quantities, it would no doubt be possible to do away with much of the present handling, such as loading from consignee's premises to lurry, lurry to railway wagon, railway wagon to lurry, and lurry to consignee's premises, to say nothing of the extra handling that takes place when merchandise is taken into railway depôts without rail connection and afterwards carted to a depôt with such facilities. Such goods would be loaded on to an ordinary road lurry as at present, excepting that instead of being placed direct into the lurry, the lurry would contain three or more crates or detachable bodies, the goods being packed into such crates. The lurry would then proceed alongside the stage, and the crates would be rolled off by means of rollers attached to the under-frames on to such stage or wagon; the reverse operation would be necessary at the destination. Thus the handling would be considerably less than by any means adopted at the present time; however, this system would not be of much assistance with a number of small consignments, requiring delivery in various directions, as the time taken up would be too long, the goods would be more liable to damage by being pulled about to get at articles required *en route*, to avoid duplicating the cartage necessary for delivery, and it would not be possible for the depôt to properly check, enter up such goods, and keep proper records.

Detachable crates as mentioned would tend to save a certain amount of trans-shipment of goods, but would not entirely do away with it.

Tramways and light railways in rural districts should be of incalculable benefit to agriculturists, in that they offer the very facilities which are so much agitated for; they form a cheap, quick and ready means of getting to the railways, and the question of high rail rates to the large central markets should soon be a thing of the past.

It is common knowledge that the foreigner invades our markets on account of the alleged preferential tariff he is favoured with, but it must not be overlooked that he sends in very large quantities in one consignment, consequently the railway company can offer a so much cheaper rate for conveyance of the produce.

It would be an easy matter for a shed to be built alongside any present railway siding with tramway sidings on the opposite side of the stage, and for the produce of a district served by tramway or light railway to be brought at low rates and in small quantities to the shed, and there handed over to a person appointed, who would keep a proper record of the produce, sender, and charges incurred. The produce might then be bulked and sent away in large quantities to the various markets, the railway companies on account of the large bulk travelling at one time being compelled to give a low rate and quick transit, by which means the excessive rates question would vanish into thin air.

The receipts on the produce and the rail charges, &c., would be rendered to the party responsible, who would divide them in proportion to the traffic forwarded by each farmer or grower, and hand over the remainder to those entitled to receive it. To carry out this idea, it would be necessary for the farmers and growers generally to form associations in their various districts served by tramways and light railways, and appoint their own servants. By loading the traffic in bulk from tramway wagons to railway wagons, they would also save considerably on terminal charges—in fact, after the initial cost of the tramway sidings and necessary shed alongside the railway siding, all terminal charges should practically cease. For large consignments of produce in truck loads, detachable bodies should be provided by the tramways or light railway companies of such a size as to be capable of riding within an ordinary railway drop-side wagon body. Such detachable bodies should be taken over from the original "deck" to the railway wagon by means of rollers attached to the underframes, and the railway companies should be allowed to use these bodies on the direct return journey homeward for other traffic, much after the same manner as is at present done with foreign stock.

The rolling stock necessary for dealing with merchandise traffic on tramways or light railways is one of much importance, and of course depends to a great extent upon the traffic in the district to be served. However, my opinion favours five distinct kinds, viz.:—

1. Flat or deck wagons, suitable for carrying "tubs" or "crates" on rollers, and by removing these for such traffic as timber, girders, portable engines, machinery, boilers, &c., The "deck" to be provided with rings for roping purposes, also provision for bolsters and stanchions, to be fixed as desired. The "tubs" should have open tops and be used for rough traffic, the "crates" to be covered boxes with end doors, in order to protect perishable merchandise against the weather. The tubs and crates to be of various sizes, say, one, two, and three to a wagon, to meet large and small consignments.

2. Box wagons, ventilated at the ends, with sliding side doors for general merchandise requiring covering, with clips inside for fixing bars and hooks for "meat traffic."

3. Open wagons—side drop doors—for traffic not requiring sheeting, not suitable to carry in box wagons, such as glass, acids, iron, oils, grease, &c., and traffic requiring sheeting, but necessary to be lifted by cranes, &c.

4. Coal wagons with side and bottom drop doors.

5. Cattle wagons, open tops, side doors, and movable partitions. Such wagons to be used for "scrap" metal, coke, &c., traffic when not required for cattle.

The carrying capacity of all wagons should not, I consider, be less than 16 tons.

The method of dealing with the men who handle the merchandise traffic must vary according to the distance covered and the quantity of traffic dealt with, also the time necessary to work same. The drivers and guards would be able to deal alone with coal and full loads of traffic "siding to siding" in small areas, and there would only be the question of time to consider; whereas with general merchandise over a larger area, necessitating depôts, col-

lecting and delivery facilities, &c., there would be the clerical and porterage staff to consider also, in which case a daily wage would be the best, the drivers and guards assisting at depôts with traffic generally when not engaged in the actual transit of same from place to place.

(To be concluded.)

TRADE MARKS AND TRADE NAMES.

We have had occasion from time to time to direct the attention of readers to important decisions in the law courts upon questions of trade-mark law, and of the right to the exclusive use of particular trade names. These matters are of considerable importance to traders generally, for the keen competition prevailing to-day in every industry makes it necessary for manufacturers to use every available means, consistent with honesty of action, to make their goods known to the public, and to this end an attractive and distinctive mark or name is often of the greatest service. The question might be asked, however, whether the possession of a valid trade mark or of a distinctive trade name for specific goods is the more valuable, and usually the cases in the law courts do not help us to answer this question, for we do not often find the two issues raised in the same case. The judges may be asked to say whether one trader has, or has not, infringed the trade mark of another; or whether the name adopted by one trader for his goods is an imitation of, or the same as, that used by another, and claimed by that other as his exclusive possession; but these two classes of action are usually distinct and are seldom combined in the one set of facts. Very recently, however, a case has been before the law courts in which both issues have been tried on the same facts, and the judgment throws an interesting light on the relative values of the two assets.

A firm of jam manufacturers, established for many years at Stockport, have been in the habit of selling their jams under the title of "Silverpan," which name was placed prominently on their labels and circulars. They also registered as their trade mark the word "Silverpan," with the signature of the firm underneath. The name was derived from the fact that, in order to secure purity, the manufacturers boiled their jams in pans lined with silver. A firm of retail grocers having a large number of shops in the Wigan district, began to sell jams under the description of "Silverpan," and the wholesale manufacturers brought an action, in the first place, for infringement of their trade mark. The defendants pleaded that the mark was not registerable, and applied that it should be struck off the register. In this action the Court of Appeal, reversing the decision of Kekewich, J., upheld the plea of the defendants, and ordered the mark to be removed from the register (Henry Faulder & Co., Ltd., *v.* O. & G. Rushton, Ltd., L.R., 1902, 1 Ch. 125). Sec. 74 of the Patents and Trade Marks Act, 1883, together with Sec. 16 of the amending Act of 1888, provides that the Comptroller may register "as an addition to any trade mark" any distinctive word, though the same is common to the trade in the goods with respect to which the application is made; but the applicant must state the essential particulars of his mark, and must disclaim in his application any right to the exclusive use of the added matter, and a copy of this disclaimer must be entered on the register. The Court of Appeal in this case held that the word "Silverpan" was at the date of its registration "distinctive" within the meaning of the Statute, and therefore that it should have been expressly disclaimed when the application was made. As this had not been done, the order was made to expunge the mark.

In this first round of the contest, therefore, the plaintiffs did not find in their trade mark the protection they had looked for, but they did not thereupon give up the contest. A fresh action was started before the Vice-Chancellor of the County Palatine of Lancaster, in which the plaintiffs sought an injunction to restrain the defendants from "passing off" their jams as jams manufactured by the plaintiffs by using the word "Silverpan." The defendants admitted using this word, but contended they had a right to do so, as the words "silver pan" were, so they alleged, commonly used in the trade by manufacturers who boiled their jams in silver pans, and also by dealers as descriptive of the method of manufacture. After hearing a great deal of evidence, the Vice-Chancellor held that the word "Silverpan" had acquired a secondary meaning as indicating jams of the plaintiffs' manufacture, and not jams made in a silver pan, and he granted a perpetual injunction. This decision has since been reviewed by the Court of Appeal, who have unanimously upheld it. (Henry Faulder & Co., Ltd., *v.* O. and G. Rushton, Ltd., the *Times*, May 9th, 1903.) All three Judges found that the name had acquired in the Lancashire district a meaning as indicating jams manufactured and sold by the plaintiffs.

The importance of this case lies in the fact that it shows that even where a trader finds himself deprived of his trade mark through some technical flaw in the registration or breach of the statutory requirements, he may still find protection for his goods in the possession of a trade name, even where that trade name cannot be registered as an exclusive mark. Of course, where the trade name is descriptive, there can be no right to exclusive use until it has acquired a "secondary meaning," as indicating, not goods of a certain material or manufactured in a certain manner, but goods manufactured by the person using that name. Perhaps the best known case of the use of a descriptive name is the "Camel Hair Belting" case, where an injunction was granted against a firm using that name for their belting, although it was actually made from a fabric woven from camel hair, on the ground that camel-hair belting was well known on the market as belting made by the plaintiffs. In the "Stone Ale" case this name was used as a trade mark as well as a trade name, and the Court ordered the name to be moved from the register, but at the same time granted an injunction against the defendants, holding that Stone Ale was commonly known as ale made by the plaintiffs (Montgomery *v.* Thompson, 1891, 8 Reports Patent Cases, 361). Thus it is clear that the possession of a distinctive trade name, or what Lord Lindley has called a "Common Law trade mark," is even more valuable than the possession of a registered trade mark.

One reason for this state of affairs is to be found in the fact that our law of trade marks is at present in an unsatisfactory condition. It is full of pitfalls for the unwary, and a manufacturer who has had a mark on the register for many years may suddenly find himself called upon to resist an application to have that mark expunged by reason of some alleged breach of the law. Manufacturers also often find difficulties put in their way by the authorities of the Trade Marks Office when they wish to register any particular mark or name. It is no doubt necessary that the authorities should guard carefully against allowing registration of a mark which resembles closely one already on the register, but unless there is this close resemblance, there should be no objection on that ground to granting the application. In practice, however, applicants often find a number of trade marks set up by the office as obstacles to the registration of their marks, which have no apparent resemblance at all to the mark forming the subject of the application. Yet, unless the consent of the owners of these marks is obtained, the authorities will not grant the application. Traders have a distinct grievance against the Department for this tracing of resemblances which do not exist, as it really amounts to a direct discouragement of registration, whereas the duty of the Department is to render every assistance to the public.

But if all manufacturers have a common grievance in this matter, those engaged in the electrical industry have a special grievance on another ground, namely, that the classification of goods made by the Trade Marks Office takes no notice of electrical apparatus, and it is extremely difficult for any person to find the proper class in which to register particular goods. The authorities appear to have found the same difficulty, but instead of revising their classification and providing proper classes for electrical machinery and apparatus, they have in a haphazard fashion distributed these goods among the classes already existing. Thus, for example, if we wish to register a trade mark for an electric lamp and turn for guidance to the official circular intended to direct the public to the proper classes for different goods, we find that "Electric Lamps (ordinary)" should be put in Class 13. Now, Class 13 is for "Metal goods not included

in other classes, such as anvils, keys, basins (metal), needles, hoes, shovels, corkscrews." If the goods specified after the words "such as" are intended to serve in any way as a guide to the public to the nature of each class, could anything be more incongruous or absurd than to classify electric lamps with anvils, shovels, or corkscrews? And why should they be classified at all as "metal goods," when the metal fittings are at the best but a very small portion of the whole lamp, and in some cases no metal is to be found in them, except the tiny platinum terminals? One is forced to conclude that the authorities have shirked their responsibilities, and have preferred to make a careless classification rather than move with the times and make changes to suit altered circumstances. Even their own old classification has been imperfectly examined in the search for the proper place to put electric lamps, for Class 18, which is intended for "Engineering, Architectural and Building Contrivances," includes "Lighting Contrivances," and this would appear to be more appropriate for electric lamps than Class 13. It may seem to some that it is not very material what class goods be allotted to, provided all such goods are in that class, but experience will teach them to change their views. They will—to keep to our illustration—feel considerably annoyed on applying for registration of a trade mark for an electric lamp, to be told that a mark resembling theirs has already been registered by another person for shovels, and that without the consent of the shovel manufacturer their application cannot be granted. Yet this is what happens. The present classification was made nearly 15 years ago, before the electrical industry had arrived at its present important position, and it is absolutely imperative that it should now be changed. Otherwise the electrical industry cannot have any fair chance of protecting its goods by means of trade marks. Trade names may still be used and, when once established, are more valuable than trade marks, but it takes many years to establish them, and manufacturers have a right to expect that they shall have reasonable opportunities afforded them to use the facilities which the Trade Mark law was intended to provide for the protection of goods.

CORRESPONDENCE.

Electric Car Drivers.

I am prompted, on reading "Driver Quick-Stop's" letter in your last issue, to say a few words on this subject. I have had trained during the past eight years, under my instructions, upwards of 1,000 drivers for electric cars. I do not find ex-railway men the most suitable. My experience is that young army reservists, who, before joining the colours, were of the country labouring classes, make excellent car drivers and loyal employés. Failing these, who have gone through a useful disciplinary training, I would prefer men of the labouring classes, when they have them put through a proper training, to discharged railway drivers, firemen, guards and shunters. These men have been spoiled for tramway driving, and would soon get discontented with tramway wages and discipline. Speaking generally, the position to which they have attained as above on the railway indicates that they are "getting up in years," whereas the best age for a man to become a good reliable electric car driver is from 22 to 25 years. My training school is the front of a car from the first day. This is the most practical school. The new hand rides on the front with a competent driver until he has been accustomed to the tricks and traps of the driver of street vehicles, and the momentum and movements of the electric car. Then, after a few days of this necessary preliminary training, he is allowed, on a quiet part of the line, on an up grade, if there is one, to take the handles and drive the car. Next he drives on the level; then on a down grade. Later he is allowed to drive through the busier thoroughfares. During these early days, and afterwards, he reads carefully his printed instructions. Next a motor inspector, several days following, takes him to the car depôt, and, with a car over the pit, shows him all the parts of the car with which as a driver he will have anything to do. And here in the depôt a graded line is provided where the car is put through various forward and backward movements, what may be called emergency movements, so as to show him not only the ordinary mode of controlling the car, but also the extraordinary mode. The suggestion of a periodical examination of the driving staff is a very good one, and is really a necessity. By exercising care in the selection of drivers from amongst the applicants, and training them in the above manner, I find that only a very small percentage, possibly not exceeding 10 per cent., fail to pass the examination of the motor inspector, who issues a certificate of competency or incompetency.

Manager.

The Electric Tunnel Danger.

An article in the *Daily Mail*, of the 13th inst., gives the details of an interview with Mr. Yerkes, in which he is reported to have said that "it is absurd to talk about covering cables with asbestos and other non-flammable material, as, when a wire breaks, the current forms an arc which destroys asbestos as readily as wood." The moral of the article is a good one—that non-flammable wood and fittings should be used on electric trains wherever possible; but the statement regarding the universal inflammability of electric cables is not strictly correct.

As Mr. Yerkes is recognised as an authority in electric railway affairs, may we point out that we make a patent cable which will not take fire, and have used the same in pit work extensively, and also upon the rolling stock of a tunnel electric railway, it being specially examined and passed by the Board of Trade for this purpose.

We agree with Mr. Yerkes that asbestos should not be relied upon; the materials we use are jute and hemp, rendered non-flammable by special chemical treatment. This can be applied as an outer cover to any type of cable.

For heavy usage, such as trailing cables, we braid over all with leather strip, and this arrangement has been highly approved of by colliery experts as the safest type in use.

Where such non-flammable cable is used, although an arc may momentarily occur under specially advantageous conditions, there would be no chance of the cable-covering itself taking fire, as *the material will not burn.*

We are quite willing to submit this class of cable to any tests that interested persons may desire.

For **W. T. Glover & Co., Ltd.**
J. H. C. B.

Manchester, *August 15th*, 1903.

Loading and Unloading Cars at Termini.

Your correspondent, "T. St. M. E.," raises an important and difficult question, and one that has taxed the ingenuity of tramway managers from the days of George Francis Train.

The circumstances of each tramway vary, but generally the remedy is to prevent an accumulation of passengers by running an adequate service and loading at both ends of the car.

Our practice is to discharge at the driver's end and load up at the rear, and when the passengers arriving have alighted, use the front for loading, and our bye-laws have been sanctioned with a clause making this legal.

I have had no experience of the "cattle gangway" system—it would not be practicable here owing to the obstruction to vehicular traffic which would result, and I am not sure that we could load any quicker by their use.

At holiday times we secure the services of the police, and two big constables in uniform at each side of the entrance are quite sufficient to secure orderly and quick admission. Our cars are 70-passenger capacity, and a 2½ minutes' service hitherto has been run to time, and I have no doubt a 1½-minute service can be run in a like manner.

The difficulty will gradually lessen as the people become accustomed to the use of the cars, as new passengers take fully 30 per cent. more time than older ones in getting on and off.

Your correspondent's suggestion for laying the cars alongside the footpath is an excellent one for ordinary use at a dead-end terminus, but is not practicable in a through service, owing to the obstruction to, and diversion of, vehicular traffic, also cars running close end on would still come to a stand and

begin to unload and pick up away from the footpath unless the alongside tramway was continued for too long a distance; besides, the pedestrian traffic would perforce take to the highway, thus endangering life and limb from passing vehicles.

There is a very good suggestion for railway dead-end termini in the *American Street Railway Review* for July 20th, 1903, p. 395. It is obvious that the rails would be laid on the ground level and sidings multiplied as required, providing there was sufficient land available.

I shall be glad to see the views of other

(Experienced) Tramway Manager(s).

Our Fiscal Policy.

I should be glad if you would allow me to point out to "A Man of No Experience" what appear to me to be flaws in his letter on the above.

For instance, he states that it can be shown that industries tend to move to, and flourish in, localities adapted to their requirements, and he claims a natural law to govern this. But this is only true when no restriction of an artificial nature is placed on this tendency. It is possible, for instance, to have a district admirably suited in every way for, say, silk weaving, and yet a tariff duty on exported silk would certainly play sad havoc with the alleged natural law. In fact, it has done so already. Your correspondent says himself that Coventry was the leading centre of the silk trade, therefore it is fair to suppose that it was, by the above reasoning, "best adapted for the industry." In that case, how is it that Coventry had to turn to watch making? As Coventry became famous for watches, I suppose it was a locality admirably adapted for watch making; and yet we are told, by the way, that the "American machine-made timekeeper spoiled the trade." This surely shows that it is possible to upset this alleged natural law without this considerable loss and waste, *except to the parties against whom the artificial obstructions are directed.*

In the case "A Man of No Experience" instances, this appears to have been Coventry, robbed of at least two trades for which it was eminently adapted, and driven to a third, at which it is now, in spite of the statement made, not too prosperous. It would appear that by great pluck, and aided somewhat by need, Coventry took up this third trade. As two trades, both of which appear to have been well adapted to the town, disappeared solely through tariffs of a hostile nature, how long does your correspondent give for the life of the third?

Now Coventry loses first one trade, then another. Neither of these trades comes back to the town. What has become of the capital invested, first in silk mills, then in watch factories? The money invested in advertising, working and distribution expenses for first the silk, then the watches? What does a skilled silk weaver do when he has to become watchmaker, and after that cycle maker? Is there anything predominant about these changes of capital and labour except loss? And loss to Coventry, not to the foreigner. I may be dense, but I do not see the blessings of Free Trade, as your correspondent appears to see them.

You spoke, Sirs, some week or so ago, about the shutting up, or suggested shutting up, of the G.E.C. carbon business, and I did not at the time of reading think the argument worthy of you. Now, as your correspondent has taken it up somewhat in a laudatory spirit, I may say that it appears to me that the case stands thus:—

The G.E.C. shut up their carbon department where, let us say, they employ 10 men. These were earning, say, 30s. each weekly, and the carbons they made were sold at £1 each, each man made one carbon, and somewhere 10 other men made bread, and clothes, and owned houses which they sold, and let for 29s. weekly, and each of the G.E.C. men took one share, and had 1s. spending money for idle, drunken, giddy, thriftless dissipation. Now, the foreigner takes the G.E.C. market, and the G.E.C. close up. Their men do not get the 30s., but carbons are only 10s. each, and there are, say, twice as many. Now there are only two courses open for the G.E.C. ex-workman. He can emigrate, and work at his trade for foreign carbon firms. In that case we lose a good workman, we lose his custom, we lose his unit in the Empire, we lose his family and descendants for the country in the future, and no reasoning will turn this into a gain. Or else a good carbon maker becomes a poor arc lamp hand, and no reasoning can show a gain in that. Another alternative I did not mention before, although it crossed my mind, is that the man might live for a few days by eating the cheap foreign carbons.

Really your correspondent's attack on Mr. Byng is funny. He suggests that Mr. Byng returns to his previous trade of underselling the Briton, and so realises the blessings of Free Trade. I do not think I have heard anything more humorous than this bold admission from a Free Trader that the man who undersells the British manufacturer is the man who realises the blessings of Free Trade. Exactly. That's what we say.

Geo. Barham.

Hot-Wire Arc Lamps.

With reference to your correspondent's letter signed "N. D. W.," criticising the above, he points out that it is possible to design a solenoid arc lamp that is capable of being switched over from continuous to alternating current circuits, and *vice versâ*. Personally, I should like to see this attempted. I can only conclude that his commercial experience in arc lighting must be rather limited, since I have frequently been asked for a change-over lamp. To quote you a case in point, Prof. Mundella, of the Northern Polytechnic Institute, particularly wanted a lamp to burn on his private supply (continuous current) and change over to the Islington supply (alternating current) and having inquired of various makers, he had to be satisfied with the ordinary solenoid arc lamp for one circuit only.

J. G.

As an engineer with considerable practical and theoretical experience with electric arc lamps when upon the staff of two of the more important manufacturers, I have been greatly interested in Mr. Tomlinson-Lee's article upon the Foster lamp, and also somewhat amused at the apparently hurried criticism of "N. D. W."

I entirely agree with Messrs. Foster & Co. that a large majority of arc lamp troubles are due to the employment of imperfectly-protected dashpots.

Any device such as the Foster lamp claims to be, that will diminish the energy losses due to electro-magnetic apparatus, must tend to increase the number possible "in series" at a given voltage. This, together with the facility for "changing-over" from continuous to alternating current and *vice versâ*, should, in my opinion, greatly assist the lamp commercially by advancing the interests of the purchaser and the dealer who stocks.

It appears to me, however, that two difficulties may present themselves:—

(*a*) Irregularity of burning where one or more lamps of a series are situated in a different temperature to the others, or where the temperature is variable.

(*b*) The inadaptability of the hot-wire system of regulation to installations where the shunt current of the lamp circuit is employed for automatic or central control.

Beyond these points, I can see material advantages to be gained by the application of the principle adopted by Messrs. Foster & Co., and a lighter and shorter lamp should be the result.

F. J. T.

Messrs. Foster & Co. ask for criticism, and I beg to offer a little. I think Mr. Foster must have been unfortunate in connection with his previous firm, in having such trouble with dashpots. I have handled considerably over 1,000 lamps of various modern makes, and have only had five or six failures due to dashpots, which in each case was due to its being too open at the bottom. He claims to be able to do without this much-abused piece of mechanism. Now I find that one of the troubles with hot-wire arc lamps (*all* makes) is that they are exceedingly liable to "pump." The strip expands too quickly and the arc has not time to form properly. When a hot-wire lamp pumps it is chronic, owing to the comparatively long time required to allow the strip to cool before it can start again.

Of this class of lamp I consider the best was made by an American firm now defunct. It was much simpler than the

one described by Mr. Tomlinson-Lee and had not that complex arrangement of levers at the bottom. This lamp pumped badly. Last Saturday I saw a Foster lamp put on its proper specified circuit and it refused to keep alight for more than 10 seconds at a time. Then, when the strip had cooled it "tried again." This went on for an hour when the lamp was switched off to be seen to. Now it *may* have been that something was out of adjustment!—we will hope so—but for a new lamp from the works and one which it is claimed is "simple" and "does not require skilled attention," well—to say the least—it is unsatisfactory.

As regards its simplicity it has certainly more parts than the best modern solenoid lamps which consist of central tube, coil, core, lifting rod and ring clutch. It also shares one bad point with several makes of solenoid lamp, viz., the case is alive.

Regarding the 72-volt continuous arc, or lower, if you use three lamps on 220 volts, I would ask your readers to recollect the effect when two lamps (of any make) are running in series, and for some reason one has a 70-volt arc and the other 90. I think they will agree that the 90-volt arc is more than 50 per cent. better than the 70-volt one, which reminds one of a open type trimmed with flat-ended carbons.

I can endorse "N. D. W.'s" assertion that "change-over" solenoid lamps can be made. They are.

I think Mr. Foster will have trouble with the top carbon holder sticking when dirt gets in the central tube.

I should like information on one point. It seems to me that there must be a comparatively large difference between the current at, say, five minutes after starting and when about to feed, as the strip has to shorten. With solenoid lamps the coil and core can be so proportioned that a very small difference in the current is sufficient to allow the carbon to feed.

Enclosed.

Wanted: A Good Commercial Incandescent Lamp.

Can any of our lamp manufacturers tell us when we are to get a good commercial incandescent lamp?—That is to say, a lamp with which our consumers of electricity may feel that they are receiving good value in light for the cash paid for current consumed. At the present time, many of the electrical undertakings in the country are experiencing a period of depression in which the new consumers of electricity are not coming on to their mains as quickly as they could wish. Of course, an electrical supply commences, so to speak, at the top, taking the cream of the consumers in the early years of its existence, and has perforce to work slowly downwards in point of the class of consumer connected, and the number of lamps per connection; but, even allowing for this, the bulk of our electrical undertakings have arrived at a period when there is not that rush of connections that they found a year or two ago. We can trace this almost entirely to the incandescent lamp, in its present stage of existence, although a triumph of electrical and mechanical construction, not giving, to put it plainly, good value in light for the money paid for the current it consumes. One fact, amongst three or four others which might be cited, will show this. When we consider that the same amount of energy used in lighting 10 16-c.p. lamps, giving 160 c.p. of light, will, when used to drive an electric motor in a clothing factory, turn 14 to 16 sewing machines and the accompanying shafting, it becomes at once apparent that an improvement in the light-producing devices is strongly needed. The advent of the Nernst lamp promised, at first, some relief in the direction of cheaper light, but the initial cost of the lamp complete, and the fact that the luminous portion is somewhat sensitive to those changes of voltage which every supply company or corporation must have at odd times, have retarded its coming into general use.

The price now charged for the unit—say, an average of 4½d., or perhaps 4d.—is not excessive, and is rapidly approaching a point when it will be difficult to make a further reduction.

What we require is a lamp that will compare favourably as regards illumination, and more particularly cost per candle-power with the incandescent gas mantle, the use of which has increased the consumption of gas, and retarded the progress of electric lighting in almost an inverse ratio.

An incandescent electric lamp taking 1 or even 2 watts per candle would increase the number of lamps connected to the mains of the bulk of our undertakings to double their present figures in a very short space of time; and I hope we may hear that the makers have something in the direction indicated well on the way towards bringing out.

H. H. M.,
Assistant Engineer.

Electric Rock Drills.

I have read with interest the article on the above subject by Mr. T. Campbell Futers in the current number of the Review, including the extracts from a letter by Mr. Lawrence, who, it is said, complained that the expense of keeping electric drills in repair was too heavy, and (from my experience to date with electric drills, I have failed, as yet, to find one which can replace the air drill, for every day use in metalliferous mining) I should very much like to read the experiences of other electricians with the electric drills, as my experience over a period of two years does not coincide with that of Mr. Lawrence. Our drills in use are Gardner's, size B. The expense of keeping the drills in repair has been practically *nil*, and the only trouble has been caused by the breaking of piston buffer springs.

This is not a fault of the machine, but can easily be traced to the machine-man, either in not keeping the drill to its work, or forcing the drill to work on a very short stroke; a machine driven in this manner will find employment for one man in renewing springs alone, but when the drill is used with ordinary care the cost of maintenance is very small indeed.

I quite agree with Mr. T. Campbell Futers in saying that the new drills do not get fair play by the men, but the miners are not the only individuals who decry the merits of the electric drill. This little form of pleasure is also indulged in by men from whom one would expect a little more sense than from an ordinary miner.

I have often heard it expressed when exhibiting these drills that they do not do the same amount of work as an air drill. They certainly do not, but, allowing weight for weight, and taking power into consideration, I think the electric drill will hold its own with any other drill on the market. The work accomplished in an eight hours' shift by two men with one drill is as follows:—Setting up column and drill, boring five or six holes of from 2 ft. to 4 ft. averaging about 18 ft. in all, dismantling and carrying drill, machine, tools, &c., back to cross-cut about 50 yards away from face; then blasting and turning back broken ground ready for the next shift. Nature of ground:—Lead, blende, and hard blue slate or country rock, fairly hard.

Charles A. Fox.

Trefriw, *August 18th*, 1903.

Entropy.

In an article on "Entropy" under my name that appeared in your pages on March 6th, I wrote that the meaning ascribed to this word had undergone change, and that it was now used as synonymous with "entropy per unit mass" as distinguished from what I called the "mass-integral" of entropy. Although this was in a paragraph-digression from the main purpose of the article, it is due to those who may have read it that I should state that I was mistaken in this point, and that I find that the most recent authorities on theoretical thermo-dynamics in England, France, Germany and America, use the word "entropy" in the sense of the "mass-integral."

Without in the least desiring to suggest the use of the word except in the sense employed by these authorities, I may, perhaps, say that, on the other hand, I myself see but little important practical application of the idea of the entropy mass-integral, while the idea of entropy per unit quantity of homogeneously-conditioned matter appears to me of the most fundamental practical importance in thermal and thermo-dynamic physics. In all our modern books upon steam and gas engine theory, so far as I know, what is referred to as "entropy" is this entropy per unit mass. The word must here be looked on as an ellipsis for "entropy per

unit mass;" but the fact that this idea alone has established itself in this sort of book seems to indicate that this is the useful form of the general idea.

Robert H. Smith.

Westminster, S.W.,
August 17th, 1903.

["EGRAVE" asks for particulars of a pantograph, which he believes to be an American idea, applied to engraving letters on metals, glass, &c. Can anyone help him to the name of makers or agents?

Another correspondent asks for the name of the makers of Craven's patent liquid starting switch.—EDS. ELEC. REV.]

COMPRESSION IN THE GAS ENGINE.

By W. H. BOOTH.

In the discussion on Mr. Humphreys's paper at the recent Engineering Conference, attention was called by myself to the faults of hydrogen and hydro-carbon gases. There is a difficulty in securing a sufficient degree of compression without danger of premature explosion. With blast furnace gas there is but little hydrogen, and this gas is therefore safer to employ than Mond or similar hydrogenous gases. Mr. Humphreys is reported to have replied that the difficulty was not experienced by him. As this question is of importance, the diagrams herewith reproduced have been

Revs., 104 p.m.; compression, 118·75 lbs.; max. pressure, 137·5 lbs. mean pressure, 62·8 lbs.

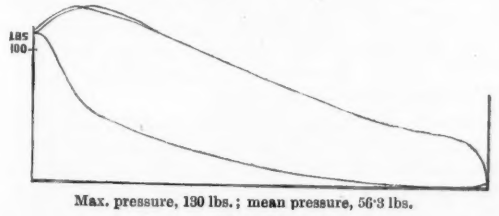
FIG. 1.

taken from a number given by a blast furnace gas engine with a cylinder 27 in. × 30 in. Fig. 1 was taken with a spring scaling 200 lbs. per in., the remainder with a spring of 100 lbs. In fig. 1 it will be observed that the compression attains to 118·75 lbs., and this is in excess of what can usually be done safely with more hydrogenous gases.

Some further information on the degree of compression to which gas engines are regularly and safely being worked would be useful to engineers generally.

Unless pistons are water jacketted, a gas engine cannot very well use a rich gas with a compression exceeding, say, five atmospheres absolute.

The diagrams are interesting also as showing a point to which the writer has previously drawn attention in these columns. This is the delayed explosion.



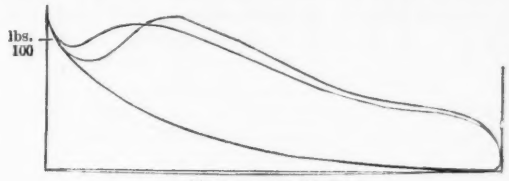
Max. pressure, 130 lbs.; mean pressure, 56·3 lbs.

FIG. 2.

It will be observed that when the piston starts out on the explosive or working stroke, there is no rise of pressure shown. The gas is evidently in course of combustion, for the diagram does not repeat the compression line, but in fig. 4 there is a momentary drop of pressure. Ultimately, in all the diagrams the pressure rises above that of compression, but does this so gradually that the old idea of explosion must be quite abandoned. There is no explosion; there is ignition, which gradually intensifies the pressure, followed by the usual expansion. In the conventional gas engine diagram, which has been laid down on steam engine lines, the explosion is sudden and severe. An enormous temperature is generated in the cylinder at a time when the piston is standing still, and the crankshaft is revolving at full speed heavily pressed against its bearings, yet receiving no turning moment from the heavily-loaded piston. The heat of explosion is going rapidly into the jacket and heating water instead of doing useful work. The crankshaft is converted into a brake.

If figs. 3 and 4 be more particularly examined, it will be found that the fullest diagrams accompany the latest and slowest ignition. This certainly appears to prove that late and slow ignition is economical, as reasoning says it ought to be.

Maximum pressure is attained when the crank is at a position of useful effort, and heat is applied to the expanding gases when they require it, and it is thus more efficiently converted into work than when set to heat the jacket water.

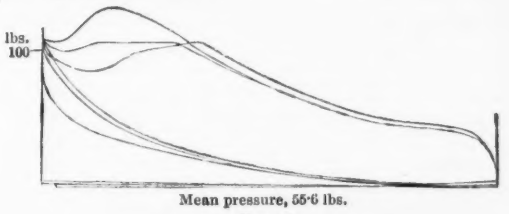


Mean pressure, 56·3 lbs.

FIG. 3.

Numerous other diagrams show the same results, and it can hardly be disputed that the late ignition is correct for the conditions met with in practice. Gas engine practice must be ruled by the conditions set by the jacket and not by any misplaced confidence in thermo-dynamic ideals which do not exist, but are rendered impossible by the water jacket.

Ideally, of course, one indicator diagram is as good as another of equal area, but practically this is not the case, the best results going with a diagram which possesses area at the best crank-angle, and does not throw away an excess of heat when the piston is standing at the dead point, a matter, it may be, of small moment in respect of the braking effect referred to above, but of considerable moment in regard to the jacket effect. Too much has been attempted in the way of copying the diagram of the steam engine, and there is no clear evidence that the vertical steam line of the steam diagram and its sharp corner are essential to economy of the highest order. As an engine, however, which to keep warm is our best endeavour, the steam engine is a superior machine to the gas engine, which has to be kept cold—a piece of sheer folly in a heat engine, only to be excused on the ground of our poor materials of construction. If, however, the jacket must be employed, it becomes wise to minimise its faults by converting heat into work at a temperature of best efficiency, which will be one that will enable the maximum proportion of heat to be converted into work, and the minimum to be wasted in the jacket, which is to the gas engine what the condenser is to the steam engine when the air pump is removed.



Mean pressure, 55·6 lbs.

FIG. 4.

The superior total efficiency of a gas engine over a steam plant, is merely due to greater compactness of the whole cycle of operations.

All the diagrams are from an engine using blast furnace gas with pistons uncooled. Can the same continuous record of high compression be shown with a richer gas, and if it can, cannot the poorer gases containing only CO be even further compressed with safety? Presumably it will not be argued that carbonic oxide ignites at lower temperatures than hydrogen.

King's College, London.—The next session commences on October 1st. Day and evening classes are held in civil, mechanical and electrical engineering, and as the College is part of the University of London, the Diploma counts towards the engineering degree of the latter. See "Official Notices" to-day.

REVIEWS.

Storage Battery Engineering. By LAMAR LYNDON. New York: McGraw Publishing Company. Price $2.50.

This book deals with storage batteries from the point of view of the general engineer or user, rather than from that of the manufacturer or specialist, and is divided into two parts. The first part deals with the general history of storage batteries, the second with their application and use.

In the commencing chapter the theory of the battery is dismissed in a few pages, the writer not discussing very deeply the various reactions, but, as the book is to be read from the point of view above-mentioned, this fact may be considered more of advantage than otherwise. The chapters following on general requirements, voltage, quantity and distribution of active material and electrolyte, give in the small space at the author's disposal an excellent *résumé* of the various points on which they treat. The chapters on internal discharge, influence of temperature, capacity variation, internal resistance and efficiency, are all excellently written, and give in a condensed form the most important points which it is so necessary for users to be acquainted with in order to get the best results from their batteries.

The next three chapters—those on durability and causes of deterioration, on diseases and their remedies, and on care in management—are by far the most important chapters contained in the first part of the book. Here are set out very clearly the difficulties which may be looked for, their causes, and the best means of overcoming them, and a good idea is given of the various troubles which arise through wrong treatment or insufficient attention. The remedies which are suggested for counteracting these troubles are in all cases well considered, although in one or two of the cases they are hardly practical, notably that referring to the rejuvenation of negative elements by reversal, and that referring to the shedding of active material by putting an envelope over the paste.

Six Chapters, XV.—XX. inclusive, refer to the many better known types of batteries, methods of formation, and manufacture. Chapter XXI., referring to assembling and installing, is also a very practical and well-written description of the best methods at present in use. That referring to testing, while not quite so interesting from a user's standpoint, deals with all the points which it is necessary to determine in order to compare any two types or systems of storage batteries.

The second part, and by far the most practical and useful to the engineer, deals with the various methods of using storage batteries both for lighting and traction circuits, and charging and regulating, automatic and otherwise. This part also treats of the various systems of boosting, both hand-regulating and automatic, and is in fact a very clear and full exposition of the various details in connection with the use of storage batteries in practice, explaining the methods and advantages under different conditions of the various systems of regulating and charging.

It is undoubtedly this last portion which will be most useful as a work of reference, and engineers who are thinking of installing batteries in connection with their supply, either for traction or lighting purposes, will find the proper conditions under which to instal and work the batteries for the nature of their requirements carefully described in this volume. The drawings are good and the book is excellently printed, there being a large number of diagrams of large size of connections, switchboards, and instruments, which are exceedingly clear.

A First Course in Machine Drawing. By GEO. HALLIDAY Wh.Sc. London: E. & F. N. Spon, Ltd.

We gather that the drawings contained in this book are intended as an exercise in tracing, and instructions for the benefit of the student are contained in the first few pages. It is, of course, almost an impossibility to make the work of the student conform to what he may be called upon to do in the drawing office, as very few of these departments adopt similar methods, and the present-day student, who has obtained a knowledge of the rudiments of machine design, and can show some sample inked-in drawings of average merit, will probably find his services in demand for something better than tracing.

For a book which lays claim to a practical character, it is noteworthy that the instructions make no mention of the use of tracing cloth, a medium which is in everyday use in the drawing office, and which may require a slight acquaintance to overcome its tendency to stretch, and its inherent greasiness.

The importance of keeping pens sharp and instruments in good order, ought to be insisted upon.

The instructions as to drawing curves, while definite as to the "pen" side of the compass, ignore the centre which is in many cases of comparatively more importance when accuracy is desired. The use of needle-pointed instruments or celluloid centres, with a view to preventing the student from digging a miniature bore hole with his compasses, deserves more attention than is usually bestowed upon it.

As photographic printing is so largely employed, it would be well to emphasise the advantages of tracing with thick lines for this purpose.

In the matter of instruments, vulcanite squares are recommended; this is surely a survival of the ancient, and ignores the many advantages of celluloid, which embrace cleanliness in rubbing (vulcanite collects grease and dirt), and a certain amount of transparency, which enables the drawing to be seen through them.

The drawings given are bold and quite suitable for the purposes stated. The value of those shown towards the end of the book would be increased if more dimensions, &c., were given, thus enabling the student to become efficient in what is, after all, the most important feature of a working drawing.

Modern Locomotive Practice. By C. E. WOLFF, B.Sc., &c Manchester: The Scientific Publishing Co.

Modern locomotives are called on to run further without a stop, to haul greater loads, and to attain greater acceleration than old locomotives were called upon to perform. But here they seem to stop. The old-time engines did faster work and quicker service, but they did it under lighter conditions.

Clarke's formula for train resistance is—

$$R = 8 + \frac{V^2}{171}.$$

To-day, M. Laboriette's formula, reduced to English, gives—

$$R = 3{\cdot}25 + \frac{V^2}{281},$$

where, as above, R = pounds per ton of engine and train and V = miles per hour.

Mr. Deeley gives—

$$R = 3 + \frac{V^2}{290},$$

which is very close to the French formula. Clarke's formula appears to-day about 5 lbs. high at 20 miles and 25 lbs. high at 90 miles. We note a misprint of 21 for 31 in Mr. Deeley's results at 90 miles on p. 3.

Experiment has shown that when running a locomotive does not slip its wheels appreciably. This has been tried, we are told, on a length of 123 miles. It is also stated that a coupling rod costs 2 lbs. of coal per mile to work it. Hence the advantage of single engines with steam sanding to start with. The Midland single is credited with having run 1¼ miles in 50 seconds, or at the rate of 90 miles per hour.

We rather agree with the author in doubting the efficiency of the steam dome, and are glad to see he discards the right of Webb's "Greater Britain" to claim the central smoke box of this "long-stomach" engine as a combustion chamber. Already the gases have passed through a set of longish tubes!

Many details will be found in the book, and also several excellent drawings of some of the latest engines. The locomotive has grown to the very limit of the loading gauge, and very little opportunity for further growth is visible.

Electrical traction men now know, perhaps, the worst they have to meet.

The book is of considerable interest. Parts might have been simplified; for example, the section on balancing, which is too mathematical, and, like much mathematical work, neglects important data—in this case the valves, which appreciably affect the question of balancing, and yet are always overlooked.

Analyses of British Coal and Coke. London: The *Colliery Guardian.*

This book is a collection of analyses of the coals of Northumberland, Durham, and Yorkshire. It is curious that British coals should be the best yet found in the world. Some of the French coals equal them in calorific power; there are good American coals, but for all-round excellence and capacity to carry long distances there are no coals like ours. Hence the foreigner comes in, and we allow our grabbing coalowners to overcharge home consumers and sell cheap to the foreigner coal which can never be replaced, and is fast going from us.

The book contains analyses and gas yields and calorific capacities. It includes a large number of analyses from all the principal seams. The calorific capacities are given for the steam coals in pounds of water evaporated per pound of coal. A few Scotch coals are added at the end of the book, which is a most useful collection of data. Further parts are to be issued to cover, we presume, all the British coal fields.

SOUTH AFRICAN NOTES.

(From our Special Correspondent at Johannesburg.)

July 27th, 1903.

Pietermaritzburg, Natal.—The tender of Messrs. Strong & Moore for the construction of the permanent way for the electric tramway system at £16,856 has been accepted.

Durban, Natal.—The municipality has now published its intention of reducing the fares on the tramway system from August 1st, and the receipts are expected to amount to £100,000 during the ensuing year from the increased traffic consequent thereon, a profit of £20,000 over expenditure.

Bloemfontein, O.R.C.—The extensions to the electric lighting system will be completed in about two months' time, and a further requisition for additional cables at a cost of £1,650, and meters at £450, has been passed.

Randfontein Estates G.M. Co.—An order has been secured from this group by Messrs. Reunert & Lenz for a 200-kw. Parsons turbo-alternator for the South Randfontein G.M.

Diamonds for Workmen.—There is an element of excitement and speculation in the Transvaal even in the prosaic job of excavating for electric light poles. Some workmen engaged in this work recently, struck the "blue" and found a two-carat diamond. This occurred in Belgravia, a suburb of Johannesburg, and a later report tells of the "blue" being struck at Newlands, a few miles out, by men engaged in well sinking, three diamonds being discovered.

Ayrshire G.M. Co., Rhodesia.—Electrical equipment at the Ayrshire G.M. consists of a 200-kw. three-phase generator, driven by a Belliss engine, which is supplied with steam from a main Babcock battery of boilers, at a pressure of 150 lbs. Current is used for both lighting and power purposes, the most important unit being an installation of two 50-h.p. motors driving the whole of the ore crushing plant. The rest of the surface plant driven by induction motors, includes a Tangye three-throw pump, having a capacity of 50,000 gallons per hour, supplying water to the mill from the Maquassi River, also workshops, cyanide and slimes plant, fuel haulage, and the lighting of both surface and underground workings.

The whole of the plant was designed by, and erected under the supervision of, Messrs. Johnson & Fletcher, consulting engineers to the company.

East Rand Proprietary Mines and the Tendency Towards Centralisation, and Transmission of Power by Electricity on the Rand.

The tendency towards the centralisation of power in the South African Mining Industry, is clearly shown in the tenders recently called for by the engineering department of this group of mines.

Tenders were for direct-coupled, steam-driven electric generators in units as follows:—One 250-kw., one 500-kw., two 1,000-kw., and one 3,000-kw. three-phase, standard type, generating current at a pressure of 2,200 volts with a frequency of 50; combinations to be used on lighting and power circuits. The engines or turbines are to be of an efficient standard condensing type, capable of standing a boiler pressure of 150 lbs. and using not more than 15 lbs. of steam per i.h.p. per hour with a steam pressure of 132 lbs., initial absolute (pressure of atmosphere = 12 lbs.), with a vacuum of 19 in.

The governing of the generators is specified not to exceed a variation in speed, from no load to full, and from full to no load, of 2 per cent. momentarily, and ½ per cent. permanently.

Centralisation will not be confined to the generation of electrical energy, but will extend to a system of workshops, mechanics', smiths', joiners' shops, &c., for the whole group, where electric driving will be, of course, a feature, and will also extend as far as is compatible with economy, to the general operations obtaining in modern mining practice, including crushing and cyaniding.

The tendency towards the utilisation of electricity for the driving of all classes of mining machinery, hitherto operated by means of endless ropes, long lines of shafting, &c., is becoming strongly pronounced, and there are at present only two operations which cannot, generally speaking, be conveniently performed by electricity. These are main surface-winding and underground rock-drilling. There are already examples of underground electric hoists, used for hauling trucks laden with ore up the steep gradients and "stopes" to the shaft bottom, and extensive experiments are being carried on with the electric drill. There is no doubt as to the greatly superior mechanical and electrical efficiency of the electric over the compressed air drill. The latter, however, is said to have the advantage of being a ventilator as well as a drill, which turns the scale in its favour. Regarding surface winding, a great deal will have to be accomplished both in design and efficiency before it even obtains notice on these fields; but a big step has been taken towards this consummation, in the papers and subsequent discussion on "Winding from Great Depths," mention of which has already been made in these columns.

Pumping, both rotary and reciprocating, by means of the electro-motor is common enough, for underground purposes as well as the surface, and there are several examples of electric driving of slimes and cyaniding plant, of electric haulage, crushing and sorting plant, the only remaining operation not yet converted to the electric drive being the stamp battery. Much discussion and speculation on this question has been going on lately, and many interesting data have been collected. At the present time all battery driving is done with compound and triple-expansion Corliss or reciprocating engines; and when the ore supply fails, as at the present time, owing to shortage of labour, these mill engines frequently run at uneconomical loads.

The system advocated by Mr. J. W. Kirkland, the manager of the South African General Electric Co., is one of electric driving operated as follows:—

Split up the battery into groups of 10 or 20 stamps, driving each group with a slow-speed induction motor. A group of 10 stamps, at 2½ h.p. per stamp, would require a 25-h.p. motor—a reasonable size where a good efficiency could be obtained—a total power of 500 h.p. for a 200-stamp mill. At these figures, Mr. Kirkland proves that the initial cost would be about the same, possibly a few hundred pounds more, which, however, taking the increased convenience and efficiency into consideration, would not weigh.

The present speed of the stamps, however, will make it difficult of realisation, the usual practice calling for not more than 50 revolutions per minute. Tests are now being made, however, with high speed stamps, which, if the efficiency allows of their installation, will appreciably simplify the problem, these stamps, on an entirely new principle, running at 126 revolutions per minute.

Indeed, there are enormous possibilities for the future of the electrical engineering industry in South Africa, which are worthy of close study and attention, and it is not difficult to predict for the profession in South Africa, and Rhodesia in particular, with its enormous water power, its vast and varied mineral wealth, a prosperous and happy hunting ground.

THE MANUFACTURE OF ELECTRIC ACCUMULATORS.

Modifications in the Draft Regulations.

In our issue of June 26th last we published the draft regulations which the Home Office had laid before accumulator manufacturers. We have now received an amended copy, in which there have been embodied certain modifications which have been made to meet as far as possible the objections taken to some of the regulations. With these alterations the trade generally is said to be satisfied as to their reasonableness, and is prepared to carry them out. We learn, however, that the present amended draft is still subject to further consideration.

If objections of substance are taken to them by the employers, by the workpeople, or by any persons affected by the regulations, these objections will, under the statute, be the subject of full inquiry by a competent person appointed by the Secretary of State, and the report of the person holding the inquiry will be considered by the Secretary of State before the final regulations are made. At the inquiry, employers, owners, occupiers, and workpeople, and all others concerned, will be entitled to a full hearing. If, therefore, any person desires the rules to be further considered, he should lodge objection in accordance with Sec. 80 of the Factory Act. Copies of the draft may be obtained on application to the Factory Department, Home Office, London, or at the local offices of the inspectors of factories, and any objections with respect to the draft regulations by or on behalf of any person affected thereby must be sent to the Secretary of State within 40 days from August 10th.

The regulations will be in substitution for the special rules for electrical accumulator works made under the Factory Act of 1891 and they are to come into force on October 1st next.

The amendments which so far have been made in the draft, as published in our June 26th issue, are not sufficiently extensive or important as to call for a reprint of the modified draft. The position will be met by our indicating the corrections thus: —

[Additional introductory note.] "The regulations . . . . shall apply to all factories and workshops, or parts thereof in which electric accumulators are manufactured."

Wherever the word "*salts*" appeared substitute "*compounds.*"

"Duties of Occupier"; part of (1) should read: —"These rooms and that in which the plates are formed, shall be capable of thorough ventilation. *They shall be provided with* windows made to open."

In (3) for "Means shall be provided for washing the floors of these rooms with a hose pipe daily," read "*The floors of these rooms shall be washed with a hose pipe daily.*"

In (4) for "Receptacles shall be provided for holding lead ashes and old plates," read "*Lead ashes and old plates shall be kept in receptacles specially provided for the purpose.*"

"Duties of Persons Employed." In (16) for "In any accumulator factory" read "*In any factory or workshop in which electric accumulators are manufactured.*"

ELECTRICAL PUMPS FOR AUSTRALIA.

At the Menangle Waterworks, Sydney, there was erected a short time ago an interesting electric pumping plant, the whole of which was specially manufactured in a very few weeks by Messrs. Mather & Platt, Ltd. The order was obtained by the firm's Sydney agents, Messrs. Gibson, Battle & Co., and comprised a 500-h.p. engine and dynamo, with surface condenser, and a 345-b h.p. motor driving a high lift centrifugal pump, with the necessary switchboards.

The engine is of the Mather & Platt double acting type, compound condensing. Its cylinders are 18 in. and 34 in. × 21 in. stroke, and it runs at 150 revolutions per minute with 160 lbs. steam.

The bedplate is of cast-iron box section, the pedestals for the bearings being cast on, and bored at one setting to ensure complete alignment. The governor is of the crankshaft type, by which the speed can be maintained, even with considerable variations of load, within 3 per cent. or 4 per cent. of the normal.

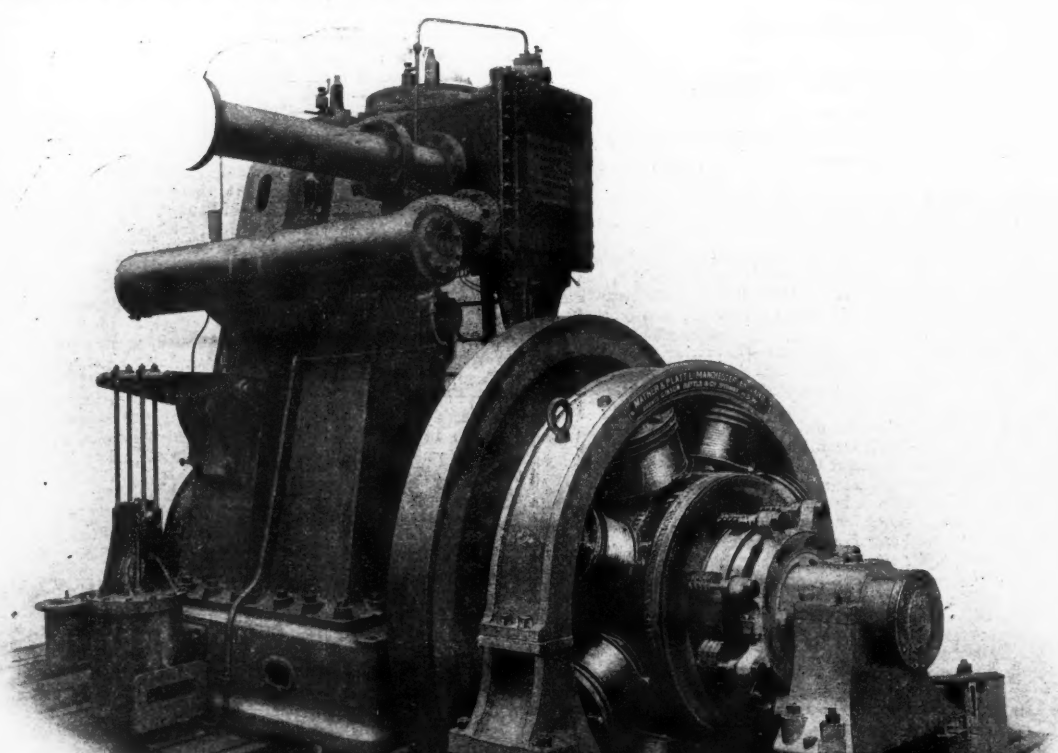
The surface condenser supplied is of the marine type with cast-iron cylindrical body and end covers, 3 ft. 10½ in. in diameter, and 5 ft. between the tube plates. The air pump, which is of the Edwards type, is bolted to the engine bedplate, and driven by rocking levers from the crosshead of the high-pressure piston rod; the pump is 13 in. in diameter, and the plunger has a stroke of 10 in. The cooling water is circulated through the condenser tubes by an ordinary 5-in. centrifugal pump driven by a belt from the engine.

The generator, which has eight poles, and is compound wound to give an output of 550 amperes at 550 volts, is carried on an extensive bedplate, the armature spider being bolted directly to the outer face of the boss of the engine fly-wheel. The yoke ring of cast-steel is circular and in two parts. The poles are of cast-steel, the pole shoes being specially shaped with the object of providing uniformity of magnetic flux, and of giving fixity of lead under varying load. The shunt and series windings are wound on aluminium spools, into which the pole-pieces are slipped, before the latter are bolted up to the yoke ring. The armature is of the slot wound type, with special provision for ventilating; the commutator is also of Messrs. Mather & Platt's well-known type, the bars being held in position by clamping rings, and the whole being carried on a cast-iron bush, which forms part of the armature core itself. Carbon blocks are used as collectors, and are carried in patented brush-holders.

The electric motor is of similar design to the generator but it has only four poles; these are cast in one with the steel yoke ring, and shunt wound. The voltage at terminals is 500 volts, and, as stated, it gives 345 b h.p. Owing to the excessively high rate of speed, viz., 720 revolutions per minute, very special attention had to be given to the construction of the commutator, which embodies several features of novelty.

The motor, as the illustration shows, is direct-coupled to the high lift pump which is designed to deliver 2,800 gallons of water per minute to a height of 265 ft.; this corresponds to a pressure of 112 lbs. per sq. in., and we learn that at a test made before leaving the manufacturers' works 119 lbs was indicated on the gauge. The motor is started by means of a combined water resistance and switch.

Messrs. Mather & Platt have recently supplied, through their Australian representatives, five other sets of the same type of centrifugal pump of smaller sizes, three being for direct driving by belt.



500-h.p. Mather & Platt Steam Dynamo for Menangle Waterworks.

STATUTORY OBLIGATIONS OF SUPPLY COMPANIES.

[by a legal correspondent.]

Seeing that those who supply electricity to the public do so under statutory obligations, it is essential that they should have the penalties inflicted by statute clearly before them. The penalties to which undertakers are liable for failure to supply, &c., are

recoverable in Courts of Summary Jurisdiction, while they are empowered to recover the rent due to them in respect of the supply of electricity to any consumer "in like manner as a penalty under the Acts." Of the many delinquencies in respect of which penalties may be recovered against a supply company, the most important is the failure to supply electricity in accordance with the terms of the provisional order.

The rights of the consumer against the "undertakers" who make default in furnishing him with a proper supply, are as follows:—

It is provided by Sec. 19 of the Electric Lighting Act, 1882 (45 and 46 Vict., c. 56), that where a supply of electricity is provided in any part of an area for private purposes, then, except in so far as is otherwise provided by the terms of the license, order or special Act authorising such supply, every company or person within that part of the area shall, on application, be entitled to a supply on the same terms on which any other company or person in such part of the area is entitled under similar circumstances to a corresponding supply. In making agreements for the supply of electricity, the "undertakers" must not show undue preference to any company or person, nor must they charge prices in excess of those authorised by the special order (*ib.* Sec. 20). The foregoing provisions clearly establish the right of a consumer to demand a supply. The method whereby he may enforce that right is prescribed in later Acts.

Sec. 30 of the schedule to the Electric Lighting (Clauses) Act, 1899 (62 and 63 Vict., c. 19), which only applies to districts outside London, provides that whenever "undertakers" make default in supplying energy to any owner or occupier of premises to whom they may be and are required to supply energy under the special order, they shall be liable in respect of each default to a penalty not exceeding 40s. for each day on which the default occurs. If the "undertakers" are not the local authority, and they make default in supplying energy to public lamps, they may be liable to a penalty of 40s. a day for each lamp (sub-Sec. 2).

A consumer may insist on being supplied with energy in accordance with the terms of the Board of Trade regulations. If "undertakers" make default in this respect, they become liable to certain penalties prescribed by the Board of Trade.

The foregoing provisions with regard to penalties are subject to the following modifications:—

(*a*) Penalties are not to exceed £50 a day in any one case, unless occasioned by wilful defaults on the part of the "undertakers."

(*b*) Penalties are not to be inflicted in respect of any default, if the Court are of opinion that it was caused by inevitable accident or *force majeure*, or was of so unimportant a character as not materially to affect the value of supply.

As to what constitutes "unavoidable accident," reference may usefully be made to the Irish case of the Sun Incandescent Company and Another *v.* The Corporation of Dublin (Electrical Review, December 9th, 1898). There the stoppage was due to a defective cable, which, when laid down, was the best known to the trade. It had given satisfaction for four years, when it was discovered that, owing to some unaccountable chemical action, the rubber was destroyed. The magistrates accepted the engineer's evidence that the failure was due to unavoidable accident, and dismissed the summons without costs.

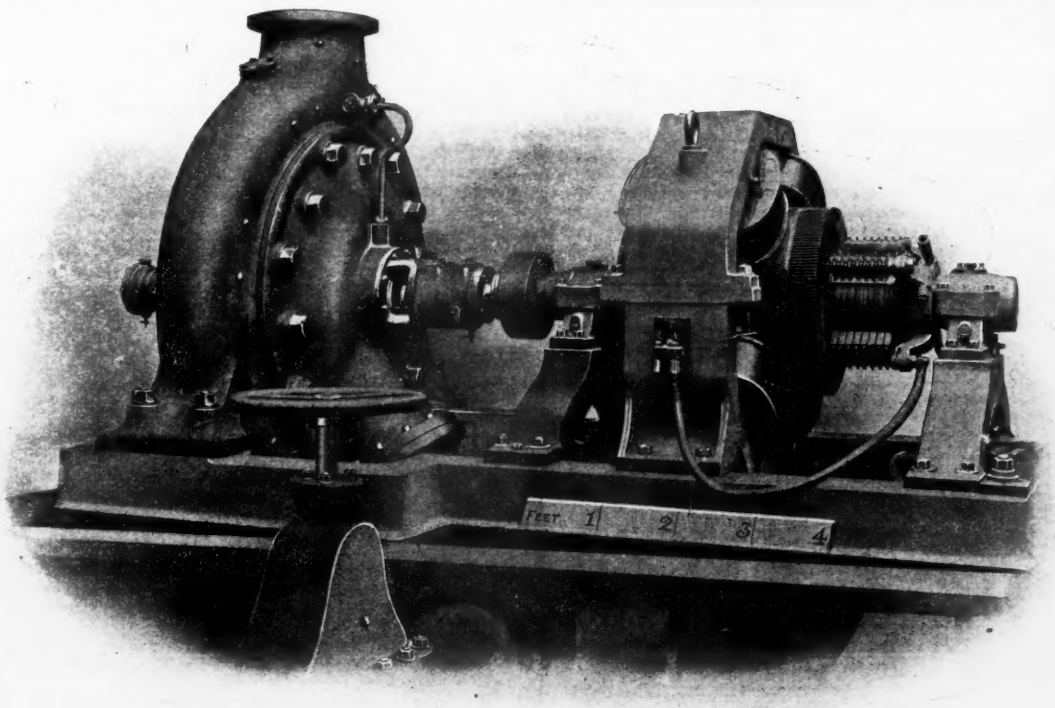
As to the recovery and application of penalties, fees, expenses and other moneys recoverable under the special Act or the Board of Trade regulations, these may be recovered summarily in the manner provided by the Summary Jurisdiction Acts (62 and 63 Vict., c. 19, Section 76 (1)). Moneys recovered by the local authority from the undertakers are applied in aid of the local rate, while penalties recovered on prosecution by any other body or person, or any part thereof, may, if the Court so direct, be paid to that body or person.

The penalties above referred to are recoverable before two Justices or a stipendiary Magistrate, and an appeal lies to Quarter Sessions. Any summons or warrant issued for any of the purposes of the Act may contain, in the body thereof, or in a schedule thereto, several names and several sums (see the Gas Works Clauses Act, 1871, 34 and 35 Vict., c. 41, s. 41). The mere fact that a justice or judge of any County Court or Quarter Sessions is liable to the payment of rent for electric energy does not disqualify him from sitting in such a Court.

An important question sometimes arises as to whether there is any other remedy open to the consumer. Experience has shown that the penalties imposed in some cases are not only too small to prevent a recurrence of stoppage of supply, but are insufficient to compensate the consumer for the inconvenience occasioned by the sudden extinction of all the lamps in his house. Two other remedies suggest themselves: (*a*) that afforded by an ordinary action at law, and (*b*) proceedings for *mandamus* to compel the company to perform its statutory duty.

The question whether proceedings at law will avail the consumer either in addition to, or in substitution for, the recovery of the penalties provided by the Acts, has not yet arisen, so far as we are aware, in relation to the supply of electricity, but it has been frequently discussed in connection with gas and water supply. The result of the decisions may be said to be that where a duty is cast by Statute upon a company or person, and penalties are imposed for failure on the part of the company to perform that duty, the company are only liable to pay penalties (Atkinson *v.* Newcastle Waterworks Company, 2 Ex. D. 441). Now, it is clear that under the Electric Lighting Acts an electricity supply company are bound to furnish their current without favour and distinction to all persons within their district; and it is also clear that they become liable to penalties in case of refusal. Hence the jurisdiction of the Courts appears to be ousted. It might be argued that in many cases similar companies have been held liable both to penalties and to an action, but a reference to those cases seems to show that the double remedy is only available in respect of the commission of acts which the company are prohibited from doing or suffering to be done. Thus, in Goodson *v.* Sunbury Gas Consumers Company 75 L.T., 251), it was held that an action would lie for nuisance which resulted in an injury to the plaintiff when driving through the streets, although the company were also liable to penalties under the Gasworks Act (10 Vict., c. 15).

The question whether a *mandamus* can be obtained from the Court to compel an electric lighting company to supply electricity has not yet arisen in the Courts. When considering the question whether a *mandamus* will lie against a public body for non-performance of a statutory duty, it is necessary to inquire whether any other remedy is prescribed by statute; for it was clearly laid down



Mather & Platt 345-b.h.p. Four-Pole Motor Coupled to High Lift Pump.

by Lord Tenterden in Doe *v.* Bridges ((1831), 1 B. & Ad. 847,859) that where an Act creates an obligation, and enforces the performance in a specified manner, it is a general rule that performance cannot be enforced in any other manner. This principle has been frequently confirmed in later cases (see Pasmore *v.* Oswaldtwistle Urban Council (1898), A.C., 387). The prescribed remedy, however, must be equally convenient or appropriate.

We have already seen that, by Sec. 30 of the Electric Lighting (Clauses) Act, 1899, when undertakers make default in supplying energy to any owner or occupier of premises to whom they may be, and are, required to supply energy under a special order, they shall be liable in respect of each default to a penalty not exceeding 40s. for each day on which the default occurs. This "remedy" probably negatives the right of a consumer to apply for a *mandamus*, but a recent case under the Water Works Clauses Act, 1847, points to the opposite conclusion. In that case the Corporation of Harwich sought a *mandamus* to compel the Tendring Hundred Water Works Company to obey the order of the Local Government Board, by providing a supply of water constantly laid on under pressure within the limits of the borough of Harwich. The defendant company was incorporated under Acts of Parliament passed in 1884 and 1886. They were not bound in the first instance to supply water under pressure, but any person requiring water was empowered to apply to the Local Government Board for an order to that effect. It was argued on behalf of the defendants that an adequate remedy was provided by Sect. 36 of the Water Works Clauses Act, 1847 (10 Vict., c. 17), which provide for payment of penalties by the undertakers upon failure to supply water in accordance with the agreement. The Court, consisting of Day and Darling, J.J., granted a *rule nisi* for a *mandamus*.

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BUSINESS NOTES.

Electrical Wares Exported.

Week ending Aug 19th, 1902.		Week ending Aug. 18th, 1903.	
Adelaide	Value £154	Alexandria	Value £43
Alexandria	51	Antwerp. Elec. fuse	336
Antofagasta. Teleg. mat. ..	50	Auckland	14
Auckland	217	Bombay	20
Bangkok	737	Brisbane	46
Bombay	560	Buenos Ayres. Teleph. cable ..	250
Buenos Ayres	143	Calcutta	2,150
,, Teleph. mat. ..	110	Cape Town	1,012
Calcutta	1,156	Colombo	22
Cape Town	826	Durban	138
Channel Islands	52	East London	873
Copenhagen	704	Gibraltar	697
Demerara. Teleg. mat. ..	365	Hong Kong. Teleg. mat. ..	43
Fanning Island. Teleg. cable	350,000	Kobe. Elec. instruments ..	923
Gothenburg. Teleph. cable ..	183	Moji. Submarine cable	284
Hamburg. Teleg. mat.	35	Montreal	40
Hong Kong	17	Nagasaki	369
Melbourne	683	Rangoon	20
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St. Lucia. Teleg. wire	44	Singapore	92
Shanghai	19	Stockholm. Teleg. wire	129
Singapore	217	Sydney	60
Sydney	1,419	,, Teleg. mat.	650
,, Teleg. mat.	206	Wellington	85
Wellington	151		
Total ..	£360,794	Total ..	£11,393

Foreign Goods Transhipped.

Rio de Janeiro. Teleg. wire	Value £168
Sydney. Elec. lamps	170
Total ..	£338

Refuse Destructors.—Messrs. Manlove, Alliott & Co., Ltd., Nottingham, have just completed an important contract for the erection of a combined refuse destructor and power plant for the Corporation of Nottingham, at which the steam power raised from the burning of refuse is utilised for generating electricity for propelling part of the tramcars running in the city. A similar plant is in course of erection by the same firm, also for the Nottingham Corporation, which will then have three installations put up by Manloves; while they are erecting destructor installations for the Corporations of Birmingham, Eastbourne, Wolverhampton and Liverpool. At the last-named city between 15,000 and 20,000 units will be generated per day (when the new installation is in full work) from steam raised from refuse burned in destructors built by Manlove, Alliott & Co. This firm has brought out a new destructor for small towns, the first of which is erected at Loughborough, and is capable of burning over 1 ton of refuse per hour. We understand that orders for several of these plants, including Grantham and Newmarket, have been placed recently.

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(*Continued on page* 307.)

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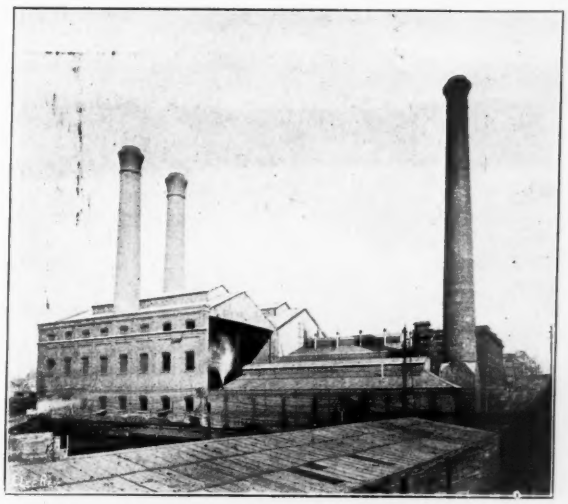
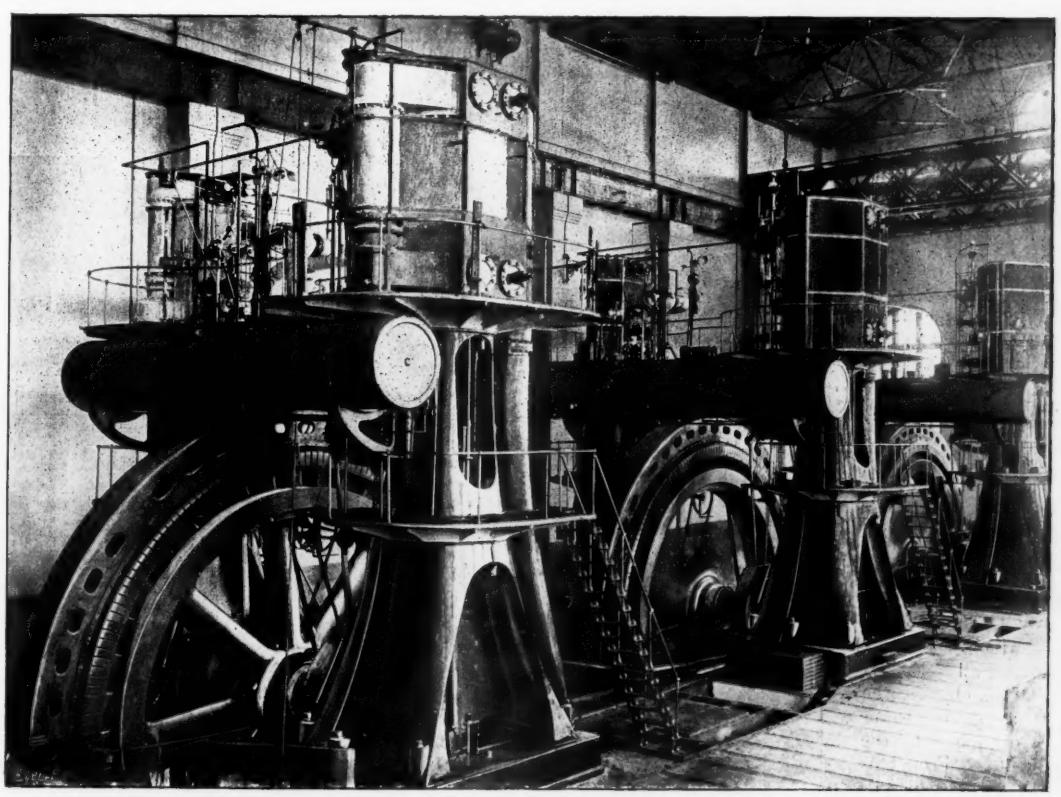


Exterior of Ultimo Power Station.



Allis-General Electric 1,500-kw. Steam Alternators.

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Rio de Janeiro. Teleg. wire	Value £158
Sydney. Elec. lamps	170
Total ..	£328

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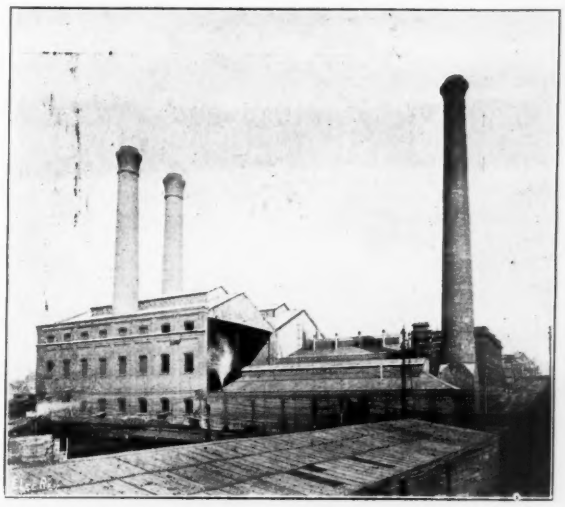
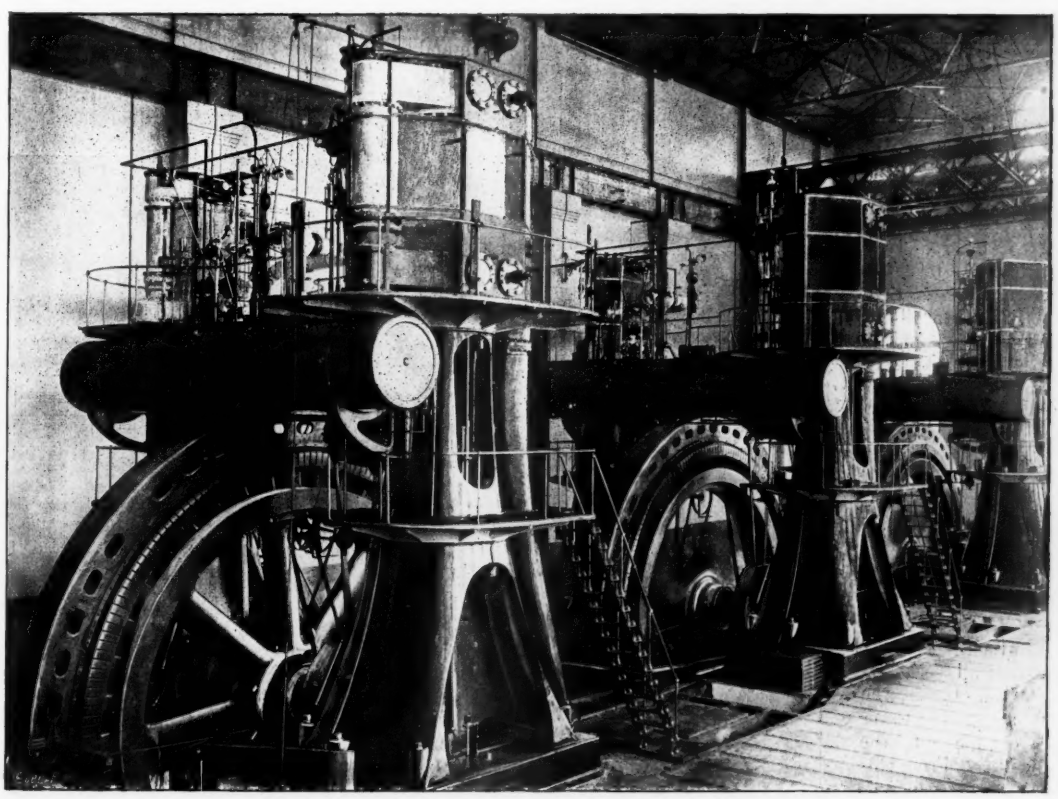
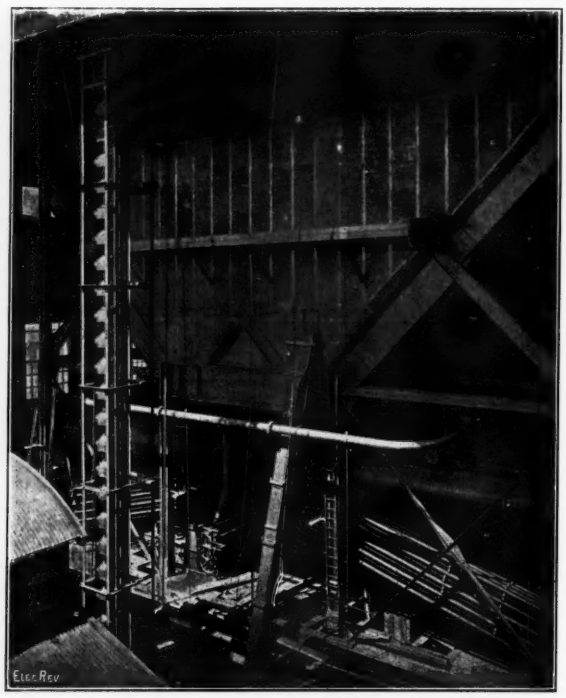


EXTERIOR OF ULTIMO POWER STATION.

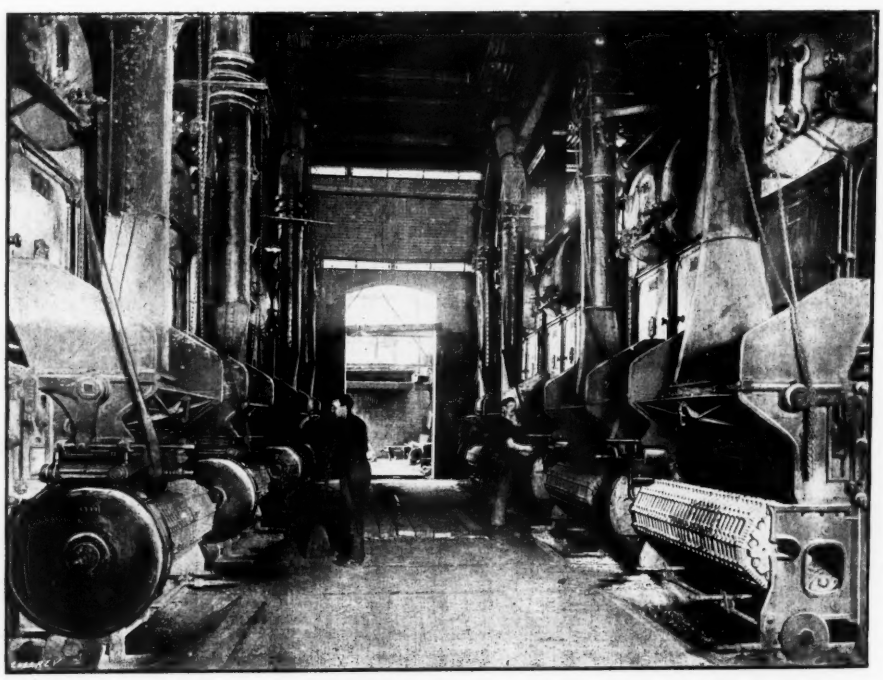


ALLIS-GENERAL ELECTRIC 1,500-KW. STEAM ALTERNATORS.

ing the total number up to 60 boilers of this type and capacity. Each boiler has 2,852 sq. ft. of water-heating surface. Under normal conditions each boiler is capable of evaporating 7,500 lbs. of water per hour. Automatic coal and ash-handling plant is used. Coal bunkers having a capacity of 2,500 tons are placed above the upper tier of boilers; the coal is dumped from the railway trucks into a crusher, which reduces it to a 3-in. gauge, and passes it on to the bucket elevator, 576 ft. long with 288 buckets. This elevator raises coal at the rate of 40 tons per hour, and can raise 50 per cent. more. The coal is carried by shoots to the stokers. The ash produced by the boilers is fed through shoots by gravity to ash cars standing under the ash hoppers in the basement of the boiler house. These ash cars deliver the ashes to the same line of buckets as previously handled the coal by which the ashes are automatically elevated to a large ash-bin at the top of a steel tower on the outside of the boiler house. From this the ashes descend by gravity, and are loaded into trucks and conveyed by rail to the ash dump anywhere along the line of railway.



Coal Bunker and Conveyor.



Babcock & Wilcox Boilers.

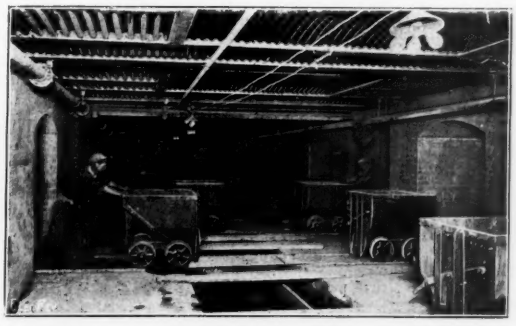
There are three compound duplex plunger feed pumps, three vertical compound beam air pumps for the condensers, and three compound horizontal circulating pumps, all of the Worthington type, and two combined air and circulating pumps for the exciter engines and stoker engines. The feed pumps have each two high-pressure cylinders, 9 in. in diameter; two low-pressure, 14 in. diameter; and four single-acting outside packed plungers, 7½ in. diameter and 10-in. stroke, capable of delivering 15,000 gallons each per hour. The circulating pumps have two high-pressure cylinders, 12 in. diameter; two low-pressure, 17 in. diameter; and four single-acting water cylinders of 22 in. diameter, stroke 16 in. The exhaust of all auxiliaries is carried to two Goubert feed water heaters, each of 1,500 sq. ft. heating surface, situated beneath the upper boiler room floor between the two new chimneys. The new feed pumps are also situated on either floor between the chimneys. The coal crusher is driven by a 20-H.P. motor, and the bucket conveyor by a 15-H.P. motor. Lubrication is carried out through a complete gravity system by means of an oil pump in the basement and a tank in the roof.

The exciter plant consists of two General Electric Co.'s 4-pole 100-KW. 125-volt compound wound D.C. generators, direct coupled to Harrisburg tandem compound horizontal engines running at 270 revs. per minute.

The new high pressure switchboard is situated on a gallery running across the engine room, between the old and new plant. There are six generator panels, five feeder panels, three exciter panels, one exciter summation panel, and one generator summation panel.

Each generator panel is equipped with three single-pole single-throw oil break switches, one switch for each phase, in separate compartments of brick and soapstone. All the switches are connected by bell cranks and levers to a mechanical switch on the front of the working board; there are also two reverse current relays, each operated by a ⅛-H.P. direct current motor. The instruments consist of one induction-type integrating wattmeter, one indicating wattmeter, ammeter for main generator, ammeter for field circuit, voltmeter reading to 8,000 volts of the Thomson inclined-coil edgewise pattern; all the instruments are connected through transformers, the actual pressure on the working board being 110 volts, and there is a clear space of 4 ft. between the two boards. In addition, there is a field switch and synchronising plug. There is also an arrangement by which the speed of the engine can be controlled by the switchboard attendant, consisting, briefly, of a ¼-H.P. series motor geared to a screw shaft, which changes the position of the governor weights and varies the position of cut-off; it is provided with limit stops in each direction, and is controlled by a switch on the board. Synchronism is indicated by the voltmeter and lamp method, the lamp being connected to two transformers, one for machine and the other for bus-bars, in such a manner that the lamp is out when synchronism is attained. There is also a push-button

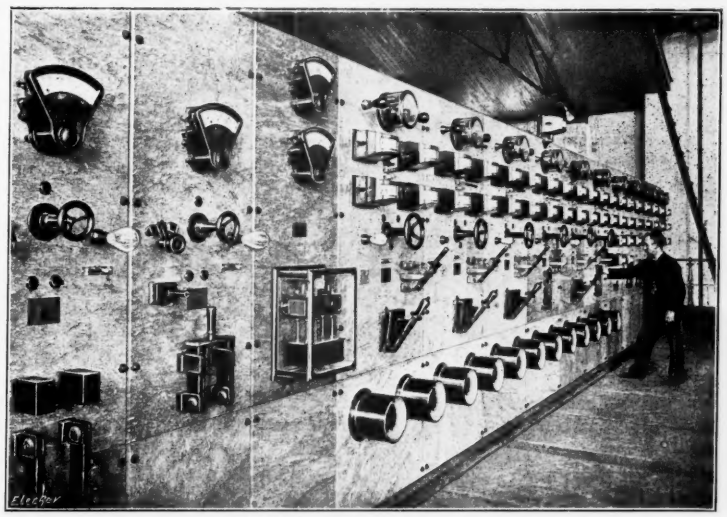
switch having three buttons—red, black, and white. The red closes a circuit, which lights a lamp and rings a gong to attract the driver's attention and to indicate that a certain



Ash Pits and Trucks.

machine should be started; the black button is used to indicate that the machine should be stopped; and the white button is used simply to disconnect either signal.

The generator summation panel measures the entire output of the station, and contains an induction total integrating wattmeter; three Thomson inclined-coil edgewise ammeters, one for each phase; three similar voltmeters to show whether the system is balanced; two Thomson edgewise indicating wattmeters, the readings of which added together give the total output at any moment, and the ratio the power factor; and a small three-pole switch which disconnects the pressure coils of all the wattmeters.



Main Switchboard.

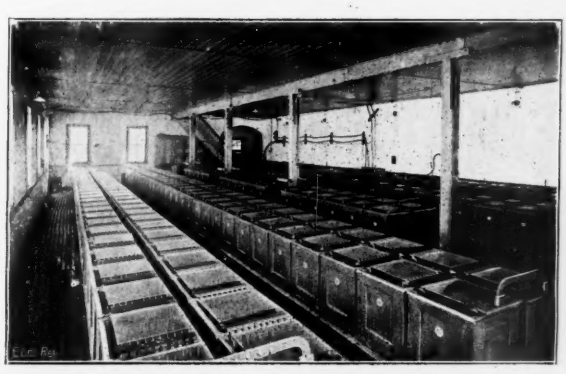
Of the five feeder panels, there are four for double-unit and one for single-unit sub-stations; each carries a switch similar to the generator switch, except that there is also an automatic attachment, which lights up a red lamp to indicate that the circuit breaker has gone, and the reverse-current relay also lights up a red lamp. There is also on each an induction integrating wattmeter and three Thomson inclined-coil ammeters.

The exciter summation panel has two voltmeters, one on the bus-bars, while the other can be plugged to either machine, also ammeters, &c. The rheostats are all below the board, and are operated by vertical shafts. The field coils of all the generators are provided with discharge rheostats.

The high-pressure current is conveyed to the sub-stations by three-core lead-covered paper-insulated cables laid solid in wood troughing, with a layer of bricks on top as a warning, the whole of this work having been carried out by the British Insulated Wire Co. Sub-stations are situated at Bondi, Randwick, Newtown and North Sydney, and one in the city at Macquarie Street, four being two-unit stations, and one a single unit. Each unit consists of three 175-KW. transformers, and one 450-KW. rotary converter (having a maximum load for two hours of 600 KW.), a storage battery of 600 KW. maximum discharge capacity, and a 100-KW. booster. In the transformer the alternating pressure is reduced to 375 volts, and in the rotary converter it is converted into direct at 600 volts. The booster is wound in such a manner that all of the peak above the output of the converter will be thrown on the battery. The sub-stations each comprise two separate buildings—the converter house, containing transformers, rotary converters, booster and switchboards, and fitted with overhead travelling crane; and the battery house. The city sub-station has a converter house 50 ft. × 30 ft., and 17 ft. high; the battery house is in two stories, the dimensions of each room being 50 ft. × 40 ft., and 10 ft. high, and contains on each story a Tudor battery consisting of 280 cells each, of a capacity of 500 ampere-hours for a one-hour discharge, manufactured by the Accumulatoren-Fabrik Act engesellschaft.

The double-unit sub-station switchboard consists of two alternating-current rotary-converter panels, two direct-current rotary-converter panels, two booster motor panels, two booster generator panels, two battery panels, and about five feeder panels; there are also two high-pressure panels carrying high-pressure switches and edgewise voltmeters reading to 8,000 volts. The alternating-current apparatus is of similar type to that on the main board; the direct-current ammeters are of the Thomson astatic type. Circuit breakers on the motors of the boosters are connected to battery circuit breakers, and all the fields are connected to discharge rheostats. The rotary converters can be either separately excited or self-exciting. The whole of the extensions to the generating station and sub-stations (except

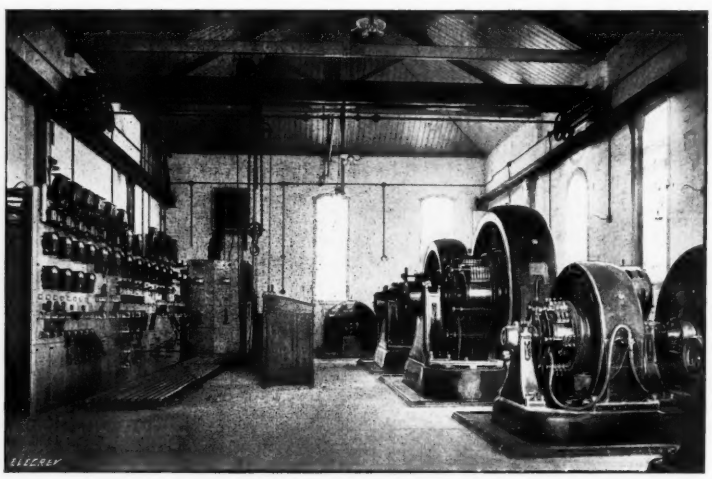
Randwick Sub-station.



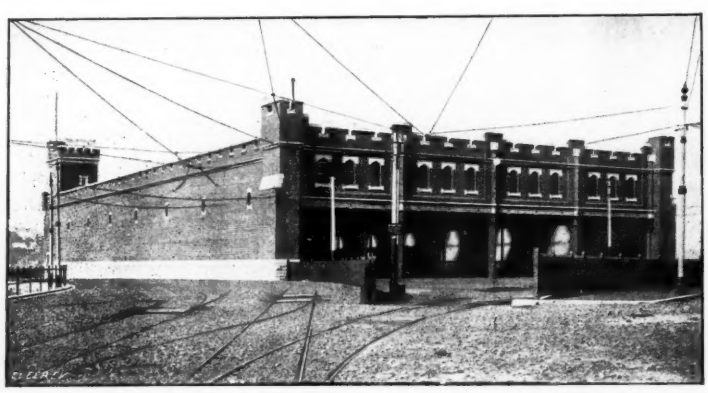
Battery Room in Sub-station.

batteries) have been carried out by the General Electric Co. (of U.S.A.).

The total length of track on all the Sydney tramways is at present about 115 miles, made up of 45 miles of double track and 25 miles of single. The overhead work for the conversion of the Ocean Street cable line is already erected, but it is not considered advisable to proceed with the changing-over until the further extensions at the power house (the installation of a new unit) have been completed. About 578 motor-cars and 52 trailers are in use, made up of 93 four-wheeled cars, 251 standard bogie cars seating 44 passengers each, 16 American bogie cars seating 49 passengers each, 16 bogie cross-seat cars seating 70 passengers each, and 202 coupled four-wheel cars with cross seats seating 45 passengers each.



Interior of Sub-station.



(By permission of the *Australian Field*.)

Car-shed, Fort Macquarie.

For the year ending July 1st, 1902, the trams ran 7,203,000 car-miles, and carried 84,000,000 passengers, earning £495,000; the working expenses were £429,000, or a return of a little over 3¼ per cent. on a capital expenditure of £2,059,000.

It should be noted also that power is supplied from Ultimo for the low-level sewage pumping scheme, for working the Pyrmont and Globe swing bridges, the grain elevators at Darling Harbour, and the whole of the lighting of Redfern station, Eveleigh Yards, Darling Harbour goods sheds, Darling Island grain sheds, &c.

(By permission of the *Australian Field*.)

Four-wheel Cross-seat Cars.

"Electric Museum."—A new publication with this title has appeared in Ceylon, dealing with electrical subjects; its editor and publisher is Mr. R. W. Hill, who apparently writes the whole of the matter, including four signed articles. The editor, we are glad to see, exposes and condemns quack nostrums, electric belts, &c., and though he too often wanders into trivialities and inaccuracies, we hope his work will be appreciated by those for whom it is intended.

RECORD OF THE E.E.R.E. VOLUNTEERS IN SOUTH AFRICA.

We are indebted to Capt. W. C. Dumble, R.E., Adjutant of the above-named corps, for the official record from the *Royal Engineers' Journal*, which we reproduce below:—

Searchlight Detachment.

The searchlight detachment, sent to South Africa in March, 1900, under the command of Major Crompton, consisted of two sections. They were on arrival attached to the military railways, and worked under Col. Girouard, R.E.

A portion of the detachment, under Capt. A. Bain, was detailed to repair the railway telegraphs in the Orange Free State and Transvaal. This portion remained throughout its service with the railways, and was employed in reconstructing and organising the railway telegraph and telephone systems and the electric block and signalling system in the Transvaal and Orange River Colonies. Capt. Bain acted throughout as chief engineer for railway telegraphs.

The remainder of the detachment was employed, during the reconstruction of the railway, in lighting the deviations and bridges during construction.

When the railway got through to Pretoria, the detachment was placed under the C.R.E. Pretoria, acting as a separate unit, and not attached to any Regular one. The men ran traction engines for transport, and put in order the electrical machinery in the forts. They installed and ran electric lights at Machadorp, Komati Poort, and at one of the general hospitals in Pretoria, current in this last case being supplied from the town mains; also installed and worked a defence searchlight at a colliery on the eastern line. The whole of the detachment returned to England in December, 1900.

Electrical Engineers' Battalion.

Almost immediately after the 1900 detachment returned home, a new detachment consisting of two companies was sent out under Major A. Bain. The establishment was later on increased to five companies, organised as a battalion, the first and only complete battalion of volunteers from one corps that has served in the field during the history of the volunteer force. These five companies formed a distinct and separate command under Major Bain, who received his orders direct from army headquarters.

They were employed on the following works:—

Lighting the large hospitals—*e.g.*, at Johannesburg, Pretoria, Elandsfontein, Kronstadt, Bloemfontein, Newcastle (Natal), Krugersdorp, De Aar (Cape Colony), &c.

Erecting and running searchlights at occupied townships—

e.g., at Heidelberg, Standerton, Ermelo, Vryheid, Vryburg, Komati Poort, Barberton, Middelburg, Klerksdorp, &c.

Running searchlights on armoured trains.

Running traction engines.

Erecting and running ice-making plant (*e.g.* at Newcastle, where from 1 to 1½ tons daily were turned out).

Lighting railway bridges (*e.g.* Norvals Pont, Bethulie, Vereeniging).

Installing and maintaining electric light in Army Post Offices, and in the offices of G.O.C.'s, &c.

Working the large permanent installation in the Artillery Barracks, Pretoria.

Assisting the Army Telegraph Department in permanent telegraph and telephone construction (a whole Company being employed for a few months towards the end of the War on this last work).

And generally doing any other electrical or mechanical work required for military purposes in South Africa (*e.g.* connecting the defences by telephone, and laying down electrically fired land mines at O'Okiep; erecting a reliable electric signal and flare system on blockhouse lines; erecting and maintaining lighting of Prisoner of War Camps, &c.).

In every case this Battalion did everything connected with their work without outside aid; erected, worked, and repaired (when necessary) all machinery; and in most cases erected engine houses, &c., as well. They supplied some 65 working parties in Cape Colony, Natal, Orange Free State, and Transvaal.

A. Bain, *Capt., E.E.R.E. (V.), Hon. Major.*

BUSINESS NOTES.

(*Continued from page* 302.)

Dissolutions and Liquidations. — Messrs. F. R. Bowyer and C. C. Pudney (Standard Electrical Engineering Co., Wellington, Salop) have dissolved partnership. Mr. Bowyer will continue the business under the old style.

The Marquand Accumulator Co., Ltd., of Cardiff, is winding up voluntarily, with Mr. R. Leyshon, 12, Mount Stuart Square, Cardiff, as liquidator, with a consultative committee (T. M. Heywood and A. J. Marquand). Creditors must send particulars of their debts by September 15th.

Messrs. E. and A. Roberts (Roberts Bros.) electrical engineers and contractors, Lee Street, Thornton Road, Bradford, have dissolved partnership. Mr. A. Roberts attends to debts.

Bankruptcy Proceedings. — At Derby Bankruptcy Court Mr. Henry John Furniss, electrician, came up for public examination. He stated that he commenced business in Queen Street, Derby, in 1889. He had no capital at the time, and it was to this fact that he attributed his failure. He had also contracted several bad debts. He was now working as an electrical instrument maker. He owed £559, and his assets amounted to £97. Some of the furniture belonged to his wife. He sold a lathe and some tools for £15 in order that he might file his petition, but no goods had been removed to any secret place. He had kept no books. The examination was closed.

Imports of Foreign Electrical Machinery and Apparatus.—The value of the imports of foreign electrical machinery into this country during July amounted to £44,744, bringing up the total for the first seven months of the current year to £357,746. July's imports of foreign electrical goods and apparatus were valued at £60,486, an increase over last year, while for the seven months ending with July the returns show a total of £421,400, as against £407,279 in the first seven months of 1902.

Belgium.—The report of the Compagnie Internationale d'Electricité, of Liège, for the last financial year shows a loss of £30,604.

Refuse Destructor Contracts.—The following letter has been sent to us for publication:—

"We notice in your issue of July 31st an advertisement by Messrs. Meldrum Bros., Ltd., which is inaccurate as to facts, and which also reflects upon other firms engaged in the erection of destructors. It is inaccurate in the following statement:—

"'Five destructors have been ordered this year—four came to Meldrums.'

"According to this Messrs. Meldrum Bros., Ltd., credit themselves with four orders during the present year, and they credit all the other makers together with one order among them.

"We have ourselves been awarded 16 refuse destructor jobs since January 1st of this year, and other firms, well known in this branch of engineering, have also obtained a considerable amount of business.

"We may add that we are fully aware that no official of a local authority would be likely to know so little of the present state of the destructor trade as to be misled by such grotesque statements as the one we have quoted, but at the same time it is possible that such ordinary members of local authorities as have not had time or opportunity to make themselves fully acquainted with the facts might be led to form very erroneous conclusions thereby.

"The Horsfall Destructor Co., Ltd.,
"G. Watson, *Managing Director.*

"Leeds, *August 18th*, 1903."

Annual Holidays.—The works of Messrs. Ferranti, Ltd., at Hollinwood, are to be closed from Friday next, August 28th, until the morning of Monday, September 7th, for the annual district holiday.

Wells v. the Stewart Electrical Syndicate, Ltd. —In the Vacation Court on Wednesday, Mr. Justice Walton appointed Mr. G. S. Pitt receiver and manager of the Stewart Electrical Syndicate, Ltd. Mr. Galbraith said the company was registered in October, 1898, and the plaintiff was the holder of a debenture bond for £2,200. On May 18th of this year the company passed a resolution for a voluntary winding up, and the creditors were now pressing. The plaintiff desired to have his interests protected.

Book Received. — "The Glasgow and West of Scotland Technical College Calendar for the Session 1903-1904." Glasgow: Robert Anderson, 142, West Nile Street. 1903.

Auction Sale.—At Hammersmith on September 1st Messrs. Percy Huddleston & Co. will offer for sale by auction a quantity of electrical plant (dynamos, motors, cable, instruments, fittings, steam and gas engines, &c.), of which some particulars are given among our advertisements to-day.

Owens College, Manchester.—The new session commences on October 6th for theoretical and practical training in electrical engineering. A notice appears among our "Educational" advertisements to-day.

ELECTRIC LIGHT AND POWER NOTES.

Arbroath.—A public meeting has been held for the purpose of discussing the question of the introduction of electric light and power into the burgh. There was an attendance of between 300 and 400 people. Mr. Addison submitted the following resolution:—"That this meeting condemns the action of the Town Council in resolving to place the electric lighting of the town into the hands of a private company, the said resolution having been adopted in defiance of the standing orders of the Council, a previous resolution being minuted and not rescinded. We therefore demand that the Council cancel it, in order to give effect to the former resolution of February, 1901." A lengthy discussion followed, and on a show of hands being taken, the Provost stated that the motion had been carried. A large number of those present did not vote, and, roughly estimated, the motion was carried by about 4 to 3.

Beverley.—The Corporation and Mr. Baker, the consulting engineer employed in connection with the scheme for installing the electric light in the borough, have agreed to refer the payment of Mr. Baker's account to the President of the Law Society, or some one whom he may appoint. This means the abandonment of the scheme by the Corporation, and the settling of the electric lighting question for some years to come.

Bo'ness.—At the monthly meeting of the T.C. Mr. Ogilvie, of King Brothers, Leith, was appointed consulting engineer in connection with the proposed scheme for electric light and power.

Boston.—At a meeting of the T.C. the Lighting Committee recommended that the question of lighting the town by electricity should be deferred for the present, and the Council approved of this course being adopted. A long discussion took place upon a resolution to affix the borough seal to the contract accepted at the last meeting for lighting the new municipal buildings with electricity. Several members urged that there was no necessity to go to the expense of a separate generating plant, and that it would be better to wait until the town was lighted by electricity. The resolution in favour of completing the contract was lost by 13 votes to seven. It was decided that conduits and wires, in readiness for the electric light, should be placed in the municipal buildings, which in the meantime are to be lighted by gas.

Bridport.—The T.C. has received a notice from the Southern District Electric Co. of its intention to apply to the B. of T. for a prov. order to supply electricity within the borough. No action was taken.

Brighton. — The Corporation Lighting Committee reports that a net profit of £7,984 13s. 9d. was made last year at the electricity works. Out of this £3,250 is to be paid to the district fund account, leaving £4,734 13s. 9d. to be carried to the reserve fund.

Bury St. Edmunds.—The T.C. has decided to adopt electricity for power purposes at the waterworks, and for this purpose a motor is to be purchased. Energy will be supplied at 1½d. per unit.

Carlisle.—A Sub-committee has been appointed to consider the desirability of altering the charges made for electricity to private consumers.

Dewsbury.—At a meeting of the Joint Hospital Board a contract with Messrs. Robb & Mitchell, Ossett, for cables, &c., at the new hospital was entered into, the price being £634 17s. 4d.

Dorchester.—The Electric Lighting Sub-committee reports having gone fully into Messrs. Enright's estimates. It has been decided to write to Messrs. Enright and inform them that the sub-committee cannot advise the Council to entertain the plans and estimates which have been submitted, and that it is not prepared to recommend expenditure of more than from £12,000 to £14,000 for an electric lighting plant to serve the compulsory area, and to ask them if they are prepared to submit plans and estimates of an efficient scheme within these limits.

East Ham.—A L.G.B. inquiry has been held into the application of the Council for £5,660 for electric light extensions.

Glasgow.—The eleventh annual report of the Corporation electricity undertaking embracing the year from June 1st, 1902, to May 31st, 1903, shows the gross revenue to be £127,004 6s. 6d., working expenses £51,138 19s. 7d., leaving a gross balance of £75,865 6s. 11d, out of which the following statutory requirements had to be met:—Interest £33,275 8s. 2d., sinking fund £11,770 15s. 7d. Out of the balance of £30,819 3s. 2d. there had to be deducted £6,536 7s. 1d., being the proportion of cost of lamps and fittings supplied to consumers consequent on change of voltage, and £992 11s. 8d., the legal and Parliamentary costs, leaving a net balance of £23,290 4s. 5d. The Committee decided that in addition to the reduction of debt by sinking fund and writing off the loss on sale of plant rendered unsuitable, by changed voltage of supply, at Waterloo Street, £6,455 7s. 2d., and at Kelvinside £1,370 13s.—there should be written off as depreciation for the year now closed a sum of £29,359 10s. 4d. The total amount for depreciation of plant thus amounts to £37,185 10s 6d., making a debit balance on the year's working of £13,895 6s. 1d., which in the terms of the Glasgow Corporation Electric Lighting Order, 1890, is in the meantime transferred to the debit of the gas account. During the year there was an increase in the sums received from all sources of £23,000, without any corresponding increase in the working expenditure. The cost of generation and distribution was less, particularly in the item of fuel, due not only to a fall in price of coal, but to a further economy on the moderate working of the previous year. This has resulted in leaving a balance on the year's working of £30,819 3s. 2d., as compared with £14,514 6s. 3d. last year. The increased surplus on the year's working has, however, been neutralised to some extent by the increased amount paid for changing over consumers' installations to the higher pressure. Subject to the modification in power rates to long consumers, and possibly an alteration of the public street lighting rates, the Committee recommend that the charges during the coming year should remain the same as last year. During the year private consumers took 10,419,488 units compared with 8,384,696 units in the previous year, an increase of 24 27 per cent. The number of consumers at May 31st, 1903, was 7,013 compared with 5,374 last year, an increase of 1,639. The number of motors supplied off the Corporation mains was 1,059 with a total horse-power of 4,597, compared with 682 last year. The number of units consumed for power purposes was 1,560,509. The total number of arc lamps in use in the streets was 719, against 500, and the quantity of electricity consumed for street and stair lighting 1,081,836 units, against 897,347 in the previous year, and the maximum load was 9,371 KW., as compared with 7,950. The steam plant at Port Dundas station has not been increased during the year, and remains at 12,100 I.H.P., but condensing plant for the two large engines has been added, and automatic coal-weighing machines have also been installed. The induced draught plant lately installed is of great assistance in meeting heavy loads. At Pollokshaws Road station there is being installed a 750-H.P. engine with two dynamos in place of two 200-H.P. engines and dynamos. The demand on this station is increasing so rapidly that it will be necessary to instal more plant shortly. Under the arrangement entered into with the Corporation tramways department, 150,096 units were taken at Pollokshaws Road works, at a total cost of £1,007 10s. 4d. A further arrangement has this year been entered into with the tramways department, by which an additional supply will be given from Pinkston station into Waterloo Street station at 6,500 volts, and be there transformed by induction motors in connection with the six existing dynamos to a pressure of 500 volts.

Gravesend.—The T.C. has received from the L.G.B. sanction to borrow £1,070 for E.L. purposes, and application for a further loan of £5,100 has been made.

Govan, N.B.—The demand for electricity has increased to such an extent that the T.C. has decided to extend the generating station at once. Plans have been passed, and the buildings are to cost £10,000, and extra plant to the value of £40,000 will be put down.

Hampton Wick.—Edmundson's Electricity Corporation, Ltd., having given notice of its intention to apply for a prov. order. The Lighting and Property Committee recommended that, without prejudice, Edmundson's Corporation be invited to send draft prov. order, and to state what conditions they propose to offer to the Council.

Horsham.—A L.G.B. inquiry has been held into the application of the T.C. to borrow £9,500 for extending the electricity undertaking. There was no opposition.

Hythe (Kent).—The T.C. has entered into an agreement with the Folkestone Electric Light Co., for the entire lighting of the town at £3 15s. per lamp per annum.

Karachi, India.—After considering Messrs. Crompton and Co.'s proposal for an electric lighting scheme, the chief officer of the municipality has found that he cannot advise the Corporation to adopt it, owing to the great increase of expenditure which would be involved.

King's Lynn.—At the recent meeting of the T.C. a report on extensions of works by the engineer was recommended for adoption. He considers that it is perfectly certain that it would pay better to lay down an additional steam dynamo rather than run the gas engines to any great extent. In a comparison of the generating costs during the 12 months ending March 31st, 1901, when only gas plant was in use, with the corresponding costs for the 12 months ending March 31st, 1903, when steam plant was used almost exclusively. Twelve months ending March 31st, 1901:—Generating costs, £1,994; units sold, 245,009; cost per unit, 1·96d. Twelve months ending March 31st, 1903:—Generating costs, £1,387; units sold, 323,175; cost per unit, 1·03d. Against the extra cost of working by gas would have to set the capital charges on £3,000, the cost of another steam set of 200 KW. The annual repayment on £3,000 would be £120, and the interest at 3½ per cent. would be £105 in the first year. There would be one satisfactory feature in the payment, viz., that the amount of repayment of capital would be purchasing new plant, whereas if the gas engines were run there would be no return for the extra expenditure. The new connections to the mains amount to between 3,000 and 4,000 lamps per annum, and in order to meet these demands, I should recommend that during next summer one additional 200-KW. set be laid down, together with two new feeder cables and certain distributing cables. Provision should also be made for expenditure on service mains and meters during the next two years. I estimate that the expenditure would be as follows:—1,200-KW. steam dynamo, together with condenser, pipes, foundations, &c., £3,225; feeders and distributing cables, £650; 250 services and meters, £1,625; total, £5,500. The actual expenditure to date is about £45,300. Therefore, total expenditure, with proposed works would be £50,800, when these extensions are carried out. This year, assuming 18,500 lamps connected at March 31st, 1904, the revenue should be £3,249. The new plant would supply 10,000 extra lamps, and when connected the revenue from private consumers for a sale of about 272,000 units should be £5,016. The total revenue would then be, approximately, as follows:—Private consumers 272,000 units, £5,016; street lamps, 180,000 units, £1,990; meter rents, £240; total, £7,246. The expenditure would approximately be:—Total works cost for 452,000 units sold at 1½d., £2,825; annual repayment on £50,800, £2,032; interest at 2¾ per cent. (on £27,000 less repayments to March 31st, 1905), say £20,660, £568; interest at 3½ per cent. (on £23,800 less repayments to March 31st, 1905) say £21,618 £757; total, £6,182. Before these extensions could be carried out the sanction of the L.G.B. would have to be obtained for a loan to cover the proposed work as well as the existing overdraft on capital account. If the above loan is obtained and the works carried out, the actual payments would be made somewhat as follows:—Payments of overdraft at bank at once, £5,820; new meters and services to March 31st, 1904; £400, new steam dynamo, &c., September, 1904, £2,500; new steam dynamo, &c., February, 1905, £1,300; new meters and services to March 31st, 1905, £600; new meters and services to March 31st, 1906, £650; total, £11,320. The recommendation of the Electricity Committee was that the report be approved and adopted, and that application be made to the Local Government Board for their sanction to a loan of £11,500 for carrying out the work and for excess expenditure over loans for the original works.

After considerable discussion, the report was adopted by 10 votes to 4, and it was decided to apply to the L.G.B. for their sanction to borrow the amount necessary.

Liverpool.—Having completed the electric lighting of London Road extension, a scheme has been proposed for similarly lighting Victoria Square, incandescent lights being proposed for the 60 corridors of the great tenement, and arc lamps for the open courtyard.

London.—ISLINGTON.—At a recent meeting of the Ratepayers' Association, the following resolution was passed, after considerable discussion:—"That the Borough of Islington Ratepayers' Association records its protest against the decision of the Borough Council to illuminate the Petherton Road with electric arc lamps, which system, under the past and present management, has been shown to be not only unprofitable, but ruinously extravagant; that, further, this association views with alarm any extension whatever of street lighting by electricity, inasmuch as this method of lighting is now regarded as being entirely superseded, both in cost and brilliance, by recent improvements in hydro-carbon vapour lamps, to which the attention of the Council is respectfully drawn, in the interest of economy."

Madras.—An electric installation, consisting of two water-tube boilers, three steam dynamos, nine motors and an electrotyping machine, 523 lamps, and four fans, put up by Messrs. F. & C. Osler, Calcutta, was opened for use the first time on July 24th at the Government Press, Madras.

Midland Power Co.—It is reported that the Midland Electric Corporation has entered into a contract for the purchase, at the Thorns, Quarry Bank, of a site for a power station for the supply of electricity in the district.

Montrose.—With a view to lighting the harbour by electricity and working the dock gates by electric motor power, the Angus Electric Light and Power Co. has been asked to furnish a report to the Harbour Board.

Newcastle.—At a recent meeting of the Finance Committee it was decided to recommend, at the next full meeting, that steps be taken to light up the Town Hall, Markets, Mansion House, Free Libraries, Central Police Station, sub-police stations, the Home for Incurables, the Weights and Measures Office, and all the Public Baths and Wash-Houses with electricity, to be produced from the power station of the tramways.

Newquay.—At the last meeting of the Urban District Council, the Lighting Committee recommended that, having regard to the estimated cost of laying down an electric light installation, the scheme be not proceeded with, and this suggestion was adopted.

Partick, N.B.—The Secretary for Scotland has granted permission to the T.C. to increase their electricity borrowing powers by £22,000, in order to extend the lighting of the burgh.

Redditch.—At a meeting of the U.D.C. a supplementary report from Messrs. Burstall & Monkhouse, of London, came up for consideration. The first report was read at a meeting a month ago, but as that was not considered to fully cover the ground 10 questions were drawn up, and to these questions the replies of Messrs. Burstall & Monkhouse were read. The first question was as to the present value of the plant compared with the original cost, and they considered that the value of the engines was 80 per cent, and of the rest of the plant 88 per cent. of its original cost. As to the question of an allowance for depreciation, they were of opinion that, provided the plant is maintained out of revenue and insured against accident, it is not necessary to create a depreciation fund. Question three dealt with the condition of the cables, and they could not actually tell the condition of the cables without taking them up, which it would be inadvisable to do. In reply to the question as to whether they considered the new engine likely to meet requirements, as they had only seen drawings of the engine, they could give no definite opinion. They considered that it was wise to push the sale of energy for power purposes, even at present prices, as the plant at the generating station has to be run during the day. The cost of adapting the present gas-producing plant for the use of bituminous instead of anthracite coal would be about £500. The report was left for consideration at a special meeting of the Council.

Rhyl.—The E.L. Committee recommended that the price of energy supplied to the Queen's Palace be raised ½d. per unit after the termination of the present agreement on August 4th. It was pointed out that the Council will risk loosing their largest customer, who, in fact, takes half the private supply, and the matter is under discussion.

Romford.—Six members of the U.D.C. have received notices that the L.G.B. auditor has surcharged them with the sum of £622 in respect to cheques signed by them for payment of expenses incidental to the promotion of an Electric Lighting and Tramway Bill. The grounds of the disallowance are based on an objection made by a ratepayer at the audit last week to the effect that the expenditure was illegal, as the sanction of the ratepayers in public meeting had not first been obtained.

Stafford.—The Gas and Electricity Committee of the Corporation have, with the consent of the Town Council, decided to make application to the Local Government Board for sanction to borrow £6,000 to cover the cost of extensions of the electric cable, including also the purchase of electric meters, this loan to be in substitution of the one for £2,200 sanctioned by the Council in April last.

Sunderland.—At the last meeting of the R.D.C. the common seal of the Council was attached to a consent to the Durham Electrical Power Distribution Co., Ltd, for the supply of electrical energy for public and private purposes in the whole of the area under the jurisdiction of the Council. This will mean competition with the Sunderland Corporation for the supply of energy to some of the shipbuilding yards near the town, but in the area of the Council. The Corporation cannot go into the Rural District Council's area without the latter's consent unless it gets a provisional order. One reason why the Rural District Council support the application is that the rateable value of the district will be enormously increased by the company's operations.

The Electricity and Lighting Committee has agreed to charge the Tramways Committee for electricity at 1⅜d. per Board of Trade unit, instead of 2d. as heretofore.

Tamworth.—The Lighting Committee reported that it had received notice from the Sir Hiram Maxim Electrical and Engineering Co., Ltd., of London, of its intention to apply to the Board of Trade for a prov. order, authorising it to supply electrical energy within the borough, and asking for the consent of the Council to the application. The further consideration of the matter was thereupon adjourned.

Thirsk.—A meeting of the Parish Council was held to consider the arrangements about lighting the town. Estimates were discussed from the Thirsk Gas Co. and the Northern Counties Electricity Supply Co., the clerk being instructed to inquire what guarantee the latter could give as to when it could commence lighting. As this was not till September 30th, the Council decided that the Thirsk Gas Co. should light the public lamps till the end of the year, and the electric lighting company be asked for its terms for the remainder of the season.

Tottenham.—At the meeting of the D.C. the Electricity Committee brought up a report by Mr. W. C. C. Hawtayne, consulting engineer, and Mr. W. H. Prescott, engineer and surveyor. The prov. order gives power to supply the whole of the district, and about 129 arc lamps would be placed on the new electric tramway columns in Green Lanes, West Green Road, and other thoroughfares, and it was expected that 50,000 to 100,000 lamps would be taken up by private consumers within two or three years. They recommended the high-pressure system with low-pressure distribution. The chimney shaft of the new dust destructor would be sufficiently large to deal, not only with the refuse gases, but also with the gases from the electricity supply works which it was contemplated to build in close proximity, and to use the power from the destructor.

The estimated cost of the undertaking was £96,500, and it would not be necessary to charge more than 4d. per unit for lighting purposes and 1¾d. for power purposes in order to work the undertaking at a profit. The income was estimated at £17,356, less £8,358 for working expenses, the net result being—estimated gross profit, £8,998, less £5,790 for repayment at 6 per cent. on loan of £96,500, leaving a net profit of £3,208. They advised an early commencement of the works, and thought the Council wise in retaining its electric lighting powers.

The clerk had written to the North Metropolitan Electric Light and Power Co. for terms, &c., on which they would be prepared to supply electricity in bulk for distribution.

The company replied giving a map of their tramway and light railway undertaking and full particulars. The Committee, however, declined the offer, and asked the engineers for a further report.

The engineers presented a modified report, giving the cost of the scheme at £59,540, and the profit at, gross £6,027, net £1,827. That scheme reduced the number of streets, part of St. Ann's Road, all Woodlands Park Road, Harringay Road, and other thoroughfares being struck out.

The Committee recommended the adoption of the modified scheme, and that application be made for a loan of £70,000 to defray the cost of the works. A three-hour discussion ensued, and it was eventually agreed that a representative of the company should be asked to attend a meeting of the Council on September 24th.

ELECTRIC TRACTION NOTES.

Carlisle.—The Electricity Committee has recommended the T.C. to make a uniform charge of 1·6d. per unit for current supplied to the Tramway Co., on condition that a 10 minutes' service is guaranteed, and a minimum consumption of 350,000 units per annum.

Failsworth.—The U.D.C. has received the B. of T. sanction to the borrowing of £25,670 in respect of tramways purchase and reconstruction. The loan will date from April 1st, when the lease of the lines to the Corporation of Manchester is deemed to have commenced. The Council has accepted the offer of a loan bearing interest at £3 7s. 6d. per cent. from the Manchester Corporation.

Glossop.—Yesterday the opening ceremony of the electric tramway system, owned by the Urban Electric Supply Co., was performed. There was a reception by the directors at the electricity works.

Kilmarnock.—A Glasgow paper says that the T.C. on 12th inst. considered accounts amounting to over £1,800 for expenses connected with the provisional order for electric traction. A good deal of discussion took place with regard to several of the items, and particularly to the charge of £262 10s. by one of the expert engineers who gave evidence, but all the accounts were passed by 13 votes to 8, the minority voting for delay.

Leicester.—About 1,100 men are engaged on the construction of the permanent way for the new electric tramways. The work is proceeding apace, and the last section of the main line has been reached.

London.—In addressing the shareholders of the North Metropolitan Tramways Co. last week, Mr. George Richardson said:—"The London County Council had not yet finally decided what system of electric traction was to be adopted on the tramways which they at present leased from them, but unfortunately their inclination seemed to be in favour of the more costly conduit system. This would mean about three times the cost of the overhead system." A resolution was passed authorising the sale to the Metropolitan Electric Tramways, Ltd., subject to the consent of the Board of Trade, of certain portions of the tramway belonging to the company in the districts of Stoke Newington and Hackney.

On Wednesday morning, under the L.C.C. schemes, a number of South London thoroughfares not previously traversed by tramways, were being broken up by gangs of men for the purpose of laying down the electric system. The important junction works at the Elephant and Castle in regard to the traffic down the New Kent Road and Walworth Road are practically completed, and it was anticipated that the two roads would be open before the end of this week.

Manchester.—There is a part of "Greater Manchester," lying within the district of the Withington Urban Council, still unprovided with tramways. The Manchester Tramways Committee lately made an offer to the Withington Council to take over on a

long lease the lines to be constructed along certain leading thoroughfares, at a rental sufficient to cover the interest and sinking fund payments in respect of the capital expenditure incurred, and to bear the cost of maintenance. The Withington Council at its meeting last week considered this question, and decided that all future lines in the district must be double, and that the work of construction could not be proceeded with until powers were obtained for widening the roads. Withington, in any arrangement that may be made, requires Manchester to pay the cost of construction and up-keep of the new lines, and the cost of carrying out the necessary road improvements and of obtaining Parliamentary powers. It is doubtful if Manchester will accept such terms, as in a few years it is highly probable the Withington District, which covers a large area, will be incorporated within the city.

American Electric Railway Statistics. — The United States Census Office has issued its report on street and electric railways for the year ending June 30th, 1902. It was prepared under the supervision of the Chief Statistician of Manufactures, and contains an enormous mass of statistical data, about 180 pp. out of the total of 193 being closely packed with small-typed tabulated matter. Many of the tables are of great value looked at from the electrical engineer's point of view, for they contain information which is worthy of study—it is a work requiring some amount of patience—respecting the physical equipment of the roads, power station plant, &c., which it is rightly suggested will be of interest to all engaged in the industry. We are glad to learn from the "letter of transmittal" of the chief statistician, Mr. W. M. Steuart, that Mr. T. Commerford Martin and Mr. E. Dana Durand are preparing a final report, which will contain an analysis of all details respecting electrical and other systems; they will also discuss the development of the modern street railway system, the generation and distribution of electric current, car equipment, and a variety of other features upon which the technical efficiency and economy of the street railway service depend. We must content ourselves at the moment by giving a few of the total results. At June, 1902, 987 companies controlled or owned 22,577 miles of single track, and their capital debt was $2,308,282,099, the average net capital liabilities per mile being $96,287.

Passengers carried	5,871,957,880
Total income	$250,504,627
,, expenses	$219,907,650
Wage-earners	133,641
Wages paid	$80,770,449
Salaried officials and clerks	7,128
,, ,, ,, ,, (salaries paid)	$7,439,716
Miles of electric line	21,920 miles
[97·2 per cent. is trolley, and wooden poles are used for 89·3 per cent.]	
Number of electric cars	61,618
,, ,, ,, carrying electrical equipments	50,699
Number of cars having fenders	43,273 (64·8 per cent.)
Cars fitted with hand brakes	63,690 (95·4 per cent.)
,, ,, ,, air ,,	7,905 (11·8 per cent.)
,, ,, ,, "other varieties of mechanical brakes"	5,148 (7·7 per cent.)
[More than half the cars are heated, 69·1 per cent. being heated by electric apparatus, and the remainder by stoves, hot water and other means.]	
Cars lighted electrically	55,703
,, ,, by oil, gas, &c.	6,666
Horses employed for operating roads	2,117

Turning now briefly to the power-house equipments, we find that 764 companies own 805 power houses, but there are others which it has been impossible to include. 540 companies use steam generators, there being 2,336 engines [total 1,298,133 H.P., or average 556 H.P. per engine], 317 having a total horse-power of more than 1,000 each [579,825 H.P., or 1,829 per engine]. Water power is used for generating purposes for 49,153 H.P., there being 159 water-wheels of 309 H.P. average. The steam boilers number 3,853 of 893,205 H.P. The following table states the number of generators, the direct current and alternating current machines being shown separately:—

Generators.	Direct current.		Alternating current.	
	Number.	Horse-power.	Number.	Horse-power.
Total	2,861	973,314	441	231,924
500 H.P. or under	2,324	422,924	329	61,935
Over 500 H.P. but under 1,000	328	218,934	54	36,418
1,000 H.P. and over	209	330,456	58	133,571

In the other pages such matters as capital expenditure, operating expenses, speeds, and accidents are shown; but our object at the moment is merely to give an outline indication of the main results.

Newcastle-on-Tyne.—The general manager of the Corporation tramways (Mr. A. E. Le Rossignol) has issued his first report on the year's working ending March 25th, 1903. This shows the total revenue to have been from all sources £153,822, and the total working expenses, including the arc lighting of the city, were £89,313, leaving a gross profit of £64,509. The working expenses are at the rate of 6·344d. per car-mile run. If the proportion of cost chargeable to the arc lighting be deducted, the net working expenses of the tramways come out at the rate of 6·174d. per car-mile run, the net traffic receipts being £150,334, or at the rate of 10·675d. per car-mile, and the ratio of working expenses to the receipts being 57·84. For the year under review there were 3,379,119 car-miles run, and 33,474,122 passengers carried. The work of the trams was commenced on December 16th, 1901, and at that time there were 14¼ miles of track available, and at the present time there are 38 miles of single track. About 140 cars are the maximum used. Mr. Rossignol says the plant has worked satisfactorily, but the increase of cars has on occasions made the margin of power very small. More is to be installed.

Prestwich.—The U.D.C. intends asking the B of T. to sanction a loan of £24,125 for the construction of tramways in Bury Old Road, &c. It is intended to continue the line from Heaton Park main entrance to Besses-o'-the-Barn, where it will join the line from Salford to Whitefield.

Sunderland.—At a meeting of the T.C. on the 12th inst. it was decided that a scarfed Dicker joint be used in connection with the Lawrence Street tram extension.

Tramway Provisional Orders. — The report of the Board of Trade of their proceedings under the Tramways Act, 1870, during the session of 1903, has been issued as a Parliamentary paper [Cd. 1,732]. It states that 14 applications were made to the Board of Trade in December, 1902, for provisional orders under the Tramways Act, 1870—namely, Barrow-in-Furness, Burton-upon-Trent Corporation, Bury Corporation, Cardiff Corporation Extensions, Halifax Corporation, Horsforth Urban District Council, Huddersfield Corporation, Ilford Urban District Council, Keighley Corporation, Leeds Corporation, Leeds and Guiseley, Newcastle-upon-Tyne Corporation, Portobello and Musselborough, and Ramsbottom Urban District Council. All the applications included power to construct new or extension tramways, and all except three were promoted by local authorities. The aggregate length of the proposed tramways was 14 miles 5 chains of double line and 21 miles 56 chains of single line, and the estimated expenditure was £447,922. The Halifax and the Ilford applications were withdrawn by the promoters. Twelve applications were granted by the Board of Trade, and provisional orders made. The Leeds and Guiseley order was not, however, proceeded with, owing to the failure of the promoters to make the prescribed money deposit. The remaining orders were submitted to Parliament for confirmation in two Confirmation Bills, which received the Royal assent on August 11th.—*Times.*

TELEGRAPH AND TELEPHONE NOTES.

Guernsey Telephones.—The *Manchester Guardian* prints some comments emanating from "A Correspondent"—generally a very indefinite source, but occasionally giving rise to suspicions—relating to the success of the Guernsey municipal telephones. It is stated that at the end of 1902 the number of subscribers' lines in existence was 937, the total lines working, exclusive of junction lines, being given at 1,073. The actual cost per line works out at £17 11s. 4d. each. The total revenue for the last year was £3,483 6s. 5d., showing an average per line per year of £3 4s. 11d. £2,717 12s. 5d. has been set aside out of revenue for capital, sinking fund and depreciation, after paying interest, Post Office royalty, and all working expenses. A special contingency fund has also been set aside out of revenue, which stands at £195 9s. 11d. After making these payments the net profit realised during the year 1902 was £157 2s. 7d. The object of "A Correspondent" is revealed in the general conclusions at which he arrives in his closing paragraphs:—"On the whole, therefore, it is safe to conclude from the experience of Guernsey that a municipal telephone system can be worked efficiently and cheaply and with some profit to the ratepayers. When the charges of Guernsey are compared with those which are made in this district, it will be seen at once that the subscribers of the National Telephone Co. are charged an excessive rate for services at least no better than those provided by the Guernsey Government."

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899	
Trinidad-Demerara No. 1	Aug. 27, 1901	
Dominica-Martinique	May 8, 1902	
St. Lucia-Martinique	May 8, 1902	
Guadeloupe-Martinique	May 9, 1902	
Martinique-Puerto Plata	July 10, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
St. Lucia-St. Vincent	Sept. 19, 1902	
Reissa-Issa	Oct. 22, 1902	
Reissa-Yemani	Oct. 22, 1902	
Paramaribo-Cayenne	Feb. 27, 1903	
New York-Haiti	April 13, 1903	
Fao-Bushire	July 28, 1903	
Bolama-Bissao	Aug. 4, 1903	
Antigua-Guadeloupe	Aug. 9, 1903	
Jamaica-Colon	Aug. 11, 1903	Aug. 14, 1903
Landlines.		
To Puerto Barrios	July 28, 1903	
Rome-Pera	Aug. 8, 1903	

Wireless Telegraphy.—A Press report from Berlin says that the preliminary Wireless Telegraph Conference came to an end on Thursday last week. The delegates of most of the States represented at the conference are said to have reached an agreement as to the most important principles for the international regulation of wireless telegraphy. Germany will, it is anticipated, shortly issue an invitation to the European naval Powers and the United States of America to hold a conference on the basis of this agreement, with a view to the conclusion of a Convention concerning the regulation of wireless telegraphy and the necessary means to be employed for putting the provisions of the Convention into operation.

Reuter reports that "an attempt" will be made to send bulletins announcing the results of the America Cup yacht races to Poldhu

by the Marconi wireless telegraphy system. "The company will send the results to Cape Cod, whence they will be repeated to Table Head, the latter place sending the news on to Poldhu."

Mr. Thomas Alva Edison *is reported* to have lately denounced the "foolish impatience of the public" at Marconi's efforts to establish trans-Atlantic commercial communication. *If* the Wizard ever permitted himself to say any such thing, he spoke in ignorance of the statements which have been made from time to time about "accomplished facts," "will be available shortly," "hundreds of messages have been sent," &c., &c. If ever there were justification for public impatience in asking for performances in fulfilment of oft-repeated promises, it is in this matter of wireless telegraphy. But what has induced Mr. Edison to make the remark attributed to him? What evidence is there of public impatience? Our own impression is that the public does not care a pin's point, so frequently has it been misled by pie-crust promises. Mr. Edison, however, indulges his weakness for prediction, and says that "in the *near future* messages would be sent at a speed of 500 words a minute," and that the "*ultimate* success of the trans-Atlantic system" is certain. No wonder the *Financial Times* says that the Marconi Co.'s shareholders would be gratified if Mr. Edison would be more precise as to his date. We suppose there is not a man who doubts for a moment that wireless telegraphy will be *ultimately* successful even across the Atlantic, but this "near future"—really it is too vague. The pity of it is that there was so much unwarrantable booming of the Marconi system before the time was ripe for a scientific and commercial success. It succeeded in creating a moderate and temporary scare among some of the old women cable shareholders, who could not be expected to know the ins and outs of the matter, but the more recent appreciation of the value of cable securities, and the comparative disregard which the question has received at the recent meetings of the telegraph companies, show that the boom has spent itself. It is hardly likely that the cable market will be affected further until the Marconi or other wireless telegraph companies succeed in doing something worth talking about, both in the direction of efficiency in long-distance transmission, speed and secrecy.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aston Manor.—August 26th. Lamps, oils, meters, for the U.D.C. See "Official Notices" August 14th.

Bexley.—August 21st. Street lamps and fittings for the U.D.C. See "Official Notices" August 7th.

Bexley.—August 22nd. Wiring buildings for the U.D.C. See "Official Notices" August 14th.

Cleckheaton.—August 22nd. Cables for the U.D.C. See "Official Notices" August 14th.

Dorchester.—August 25th. The Corporation wants offers for "assisted" wiring. See "Official Notices" to-day.

Edinburgh.—August 26th. Arc lamps for public lighting. See "Official Notices" August 14th.

Germany.—Tenders are at present being invited by the Municipal Authorities of Tubingen for the supply of a new steam engine and dynamo for the municipal central electric lighting station, at an estimated cost of £2,500.

The Municipal Authorities of Riesenburg, Western Prussia, are inviting tenders for the establishment of a central electric lighting station in the town.

The Municipal Authorities of Wangen (Wurtemburg) are at present inviting tenders for the concession for the electric lighting of the public streets and buildings.

Grimsby.—The Corporation wants tenders for a motor balancer and switchboard, and underfeed stokers to four boilers. See "Official Notices" August 7th.

Guadeloupe.—August 29th. Tenders are being invited until August 29th next by the municipal authorities of Point à Pitre (Guadeloupe) for the concession for the public and private electric lighting of the town.

Holland.—October 1st. Tenders are being invited by the municipal authorities of Utrecht for the construction and equipment of a central electricity station for lighting and power purposes, and for the working of a tramway.

Hungary.—August 31st. Tenders are being invited until the 31st inst. by the municipal authorities of Besztercsebanya (Neusohl) for the establishment in the town of a central electricity generating station of a capacity of 500 H.P.

Ipswich.—August 28th. Light and power installation in generating station, &c. See "Official Notices" to-day.

Launceston (Tasmania).—September 28th. 500 or more electric meters. See "Official Notices" June 12th.

London.—October 6th. Four 5,000-H.P. vertical-horizontal steam engines, each suitable for driving a three-phase generator, for the Greenwich power station. See "Official Notices" July 24th.

New South Wales.—September 12th. Tenders are being invited by the Railway Commissioners for New South Wales for an additional generating set of 1,500 KW. for their tramway power station.

Pietermaritzburg.—September 7th. Poles and overhead equipment for the Corporation tramways. See "Official Notices" to-day.

Portugal.—October 21st. Tenders are being invited until October 21st by the Portuguese Ministry of the Colonies in Lisbon for the concession for the electric lighting of the town of Macao in the Portuguese Colonies.

Radcliffe.—September 5th. Tramway and lighting feeders, cables, conduits and accessories. See "Official Notices" to-day.

Spain.—August 25th. Tenders are being invited until the 25th inst. by the Spanish Post and Telegraph authorities for the concession for the establishment and working during a period of 25 years, of a telephone exchange in the town of Perona. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, Carretas, 10, Madrid.

Spain.—August 25th. The Spanish Post and Telegraph authorities are inviting tenders until the 25th inst. for the establishment of telephonic communication between Gijon (Ovildo province) and Pola de Siero *vid* Granda and La Collada. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, Carretas, 10, Madrid.

Stoke-upon-Trent.—September 11th. Pipe-work, non-conducting covering, and water-softening plant for the electricity scheme. See "Official Notices" to-day.

Swindon.—August 26th. Rails, permanent way, and paving for Corporation tramways. See "Official Notices" July 31st.

Turkey.—Tenders are at present being invited by the Turkish Post and Telegraph Authorities in Constantinople for the supply of 20 tons of iron telegraph wire, 5 mm. diameter, 85 tons ditto 4 mm. diameter, 13,000 porcelain insulators and a large quantity of miscellaneous telegraph supplies.

West Ham.—August 21st. Traction switchboard, booster, &c. See "Official Notices" July 31st.

CLOSED.

Bury St. Edmunds.—The T.C. has accepted the tender of Mr. F. Espir for the supply of accumulator boxes at 7s. 6d. each.

Derby.—The Chloride Co. is to supply accumulators to the electricity works at £2,813; and Messrs. Johnson & Phillips will supply switchboard work at £1,276.

Heston and Isleworth.—The contract for the supplying and erecting of arc and glow lamps for street lighting was placed with Messrs. W. T. Henley's Telegraph Works Co., who are also supplying the feeders, as noted in this column last week.

Hove and Colchester.—The Hove Electric Lighting Co. has placed an order with W. T. Henley's Telegraph Works Co. for the supplying and laying, on the solid system, of paper-insulated feeder cables. The same company has also secured the contract for tramway feeders for the Colchester Tramways as sub-contractor to Messrs. J. G. White & Co.

Johannesburg.—A Reuter dispatch from Johannesburg says that the tenders sent in for the supply of the material of the municipal electric tramway were to be considered by the Municipal Council last Friday. The Tramway Committee recommended the acceptance of the Brush Electrical Engineering Co.'s tender for grooved and Vignoles rails and fishplates, of Belgian make, at £74,549, with 2½ per cent. discount. In the course of an interview, the municipal engineer said that if British manufacturers insisted on prescribing the quality of the goods which they were willing to supply instead of making what their customers asked for, they could hardly complain if they failed to secure orders.

Sunderland.—The Council has accepted the tender of Messrs. J. H. Holmes & Co. for an additional tramway switchboard panel; that of the Harrison Patent Filter Co. for a feedwater purifier; and that of Mr. J. Crosby, of Newcastle, for steam pipe coverings.

ADDENDUM TO ELECTRIC TRAMWAYS LIST.

GLASGOW.—Electrical engineer, E. T. Goslin. Miles of track, 64⅝ double, ⅛ single. Rails, 100 lbs. per yd. Motor-cars, 611. Capital outlay, less depreciation, £2,129,512. Annual car-mileage, 14,008,750. Pass. carried, 177,179,549. Cost per car-mile, 7·40d. Ratio of expenses to receipts, 65·79 per cent. Delete ch. eng. W. Clark. Nine miles to construct.

THE CENTRAL STATION ENGINEER.

The Ipswich T.C. has confirmed the appointment of Mr. Frank Ayton as engineer and manager of the electricity and tramways undertaking at £400, to increase by £40 per annum for three years. Mr. Ayton has been acting as Messrs. Kennedy & Jenkin's resident engineer at Ipswich since October last.

The Eastbourne T.C. has increased the salary of Mr. J. K. Brydges, the borough electrical engineer, from £350 to £400.

The U.D.C. of Farnworth has increased the salary of Mr. Pember, electrical engineer, by £50 a year.

Mr. H. B. Pooley, manager of the gas and electricity department of the Stafford Corporation, has had his salary raised from £400 to £500.

An error occurred last week in our note respecting the new appointments at Hull. These should have been stated thus:—Mr. H. Bell to be city electrical engineer; Mr. J. Wilkinson to be tramways electrical engineer.

There were 35 applications for the post of assistant electrical engineer at Bray, and Mr. A. T. Evans, of Wolverhampton, was appointed.

NOTES.

Motor-Car Reliability Trials.—The Automobile Club has made arrangements for the fifth annual reliability trials of motor-cars to take place from September 18th to 26th. We are informed that the trials will be of reliability and *not* speed. Elaborate rules have been drawn up, whereby over 130 cars, each of which will be under the continuous observation of an official Club Observer, will cover 1,000 miles at slow touring speed. It will be the Observer's duty to note every stoppage for repairs or adjustments, and even for filling the petrol tanks, so that an absolutely reliable report will be obtained as to the performance of the cars over that distance. In addition to considering ordinary reliability, a number of other points are to be taken note of in making the awards for these trials. Probably the one which will be the most appreciated by the British public is the award of marks for absence of dust raising. The effect of these trials will be to draw the attention of the makers to this important question, and so to greatly popularise the use of such vehicles. The routes of the trials will extend from the Crystal Palace to various seaside places and back on the same day. The places visited include Margate, Folkestone, Eastbourne, Bexhill, Brighton, Worthing, Southsea and Winchester.

The London Traffic Commission.—We read in the *Times* that the sub-commission of six members who have been delegated to investigate all the systems of traction and transport in the United States will sail on September 18th for New York. The Commissioners are expected to return about the middle or end of October. They will visit, among other places, New York, Boston, Philadelphia and Chicago. The most important of their duties will be to look closely into the comparative merits of subways and tube railways. On their return the Commission will resume their sittings in November. Up to the present time they have been concerned mainly with the evidence of the London County Council, which is not yet quite finished, and they will proceed with witnesses from the municipal borough councils and other local authorities in the vicinity of London who are interested in the question of metropolitan transit. Afterwards they will receive evidence from the great railway companies and tube railway companies. The Commission do not intend to report on the locomotion in London until they have personally examined into the means of transit which exist in the great cities of America and Europe. The report will probably be presented to Parliament at the close of next year. It is *so* satisfactory to learn that we have only to wait another year and a half for some opinions on a matter which mistaken men have regarded as one of urgency.

Appointments Vacant.—Two shift engineers (£120) and two switchboard attendants (35s.) are required by the Central Electric Supply Co.; a shift engineer (30s.) is wanted for Canterbury; Portsmouth—two assistant engineers, salary £105, rising to £120; assistant engineer for Kendal electricity works (£120); switchboard attendant for Carlisle (25s.); clerk for Ilford E.L. Department at £100; arc lamp mechanician for Islington. See "Official Notices" to-day.

Electric Shock Accidents.—An employé at the Levenshulme station of the Manchester electricity department received a severe shock on 8th inst., through touching a lever with an ungloved hand.

On the 16th at about 9 o'clock, a horse which was crossing the rails of Volk's Electric Railway, stepped on to the live conductor and was at once electrocuted. The line is worked at a pressure of only 160 volts. Current is only switched on to the line in short sections automatically as the cars pass over.

Personal.—Mr. J. R. P. Lunn, borough electrical engineer, Darlington, has been appointed general manager of the electric tramways which are being laid down in that town.

Utilising Exhaust Steam in Condensing Turbines.—Prof. A. Rateau's paper on the above subject, read at the Newcastle meeting of the North of England Institute of Mining and Mechanical Engineers, dealt with the question of utilising steam exhausted from intermittently running engines, by allowing it to escape into an accumulator and be used thence through a condensing turbine. The accumulator is simply a low-pressure boiler of vertical form containing trays of water which, with alternate higher and lower pressure, will absorb steam or give it out again. Winding engines specially claim the author's attention. He cites the case of those at the No. 5 pit of the Bruay Colliery in the Pas de Calais field. The engine winds from a depth of 755 ft., makes about 50 winds per hour, and uses about 17,500 lbs. of steam, owing to the unfavourable conditions under which such engines must work exposed to intermittent cooling effects. Of this, 3,500 lbs. is supposed lost by condensation, leaving 14,000 lbs. per hour for further use; and this, he calculates, would produce 400 net electric horse-power-hours if used through condensing turbines. For obvious reasons, a winding engine cannot be of condensing type, and all will be familiar with the loud exhaust of the colliery winding engine and appreciate the possibility of turning this to good use in generating electricity for lighting and power purposes.

The author would turn all waste steam into the accumulator, and secure from it the energy of condensation. Similarly he treats of the case of a steel works making intermittent draughts on power provided by rolling-mill engines. It is not unusual for such an engine to use 44,000 lbs. of steam per hour. This would suffice to drive an engine of 1,000 E.H.P. He considers that such power is more cheaply to be obtained than the same amount of power through the agency of blast-furnace gases.

The economy of the author's system is twofold. First, boilers are economised, and several hundred electrical horse-power may be got with no increase of boilers; and, secondly, coal is economised.

He gives some rough calculations of economies to be expected. The accumulator at Bruay contains 30 tons of cast-iron basins about 4 in. deep each. The pressure in it varies from 0 to 5·7 lbs. per square inch. Should the turbine draw out the whole of the accumulated energy available it would be automatically supplied with boiler steam. One would suppose that less iron and more water would have produced a more efficient accumulator, the product of the specific gravity and of the specific heat of water and of iron being in favour of water.

The Rateau system has in effect been carried out, says Mr. Walton Brown, at the Farme Collieries, by turning the exhaust of a 24-in. high-pressure beam pumping engine into a low-pressure boiler, whence was drawn the steam for a pumping engine of 60 in., and a 42-in. winding engine working at 5 lbs. pressure only. Steam flows into a vacuum at so high a velocity that the turbine certainly appears well suited for using the energy of flow of such steam on its way to the condenser.

The Rateau system of combined engines certainly merits consideration, and should be useful to electrical engineers and managers of mines who wish to instal electrical power. They may do so thus without increase of boiler plant or coal consumption.

Sweet are the Uses of Advertisement!—The newspapers of Oklahoma are severe on storekeepers who do not advertise properly. The following illustrates the method of attack:—A donkey stepped into a store, and the proprietor approached the beast and asked: "What are you doing here? You know this is no place for a donkey." "I am here," said the donkey, "because I saw your advertisement on the fence that surrounds my pasture. I knew you too must be a donkey, or you would place your advertisement in a paper, where it would be read by people, not donkeys. Being lonesome to-day, I thought I would be neighbourly and make a fraternal call."

Electrical Workers in South Africa.—Steps are being taken for the formation of a South African branch of the Electrical Trades Union. Mr. H. C. G. Oakshott, a consulting engineer, of Graham's Town, is responsible for the movement, and in a letter to the *South African News* last month he wrote:—"I am informed that at the present time a large number of electrical workers are being recruited for South Africa. I have ventured to place before the English committee the precise conditions of employment in South Africa, and have at the same time warned members of the Union of the exact state of our labour market here. The substance of my report is to the effect that although one hears from all quarters that that market (as far as electricians are concerned) is overstocked, the facts of the case are that it is only overstocked in one sense, and that is, that there are numbers of incompetent electricians out of employment. I have received communications from mine managers on the Rand and elsewhere, stating that there are always openings for competent and steady men. It is therefore necessary, in order that both employers and employés may be protected, that a system of registration should be inaugurated, and I hope the time may soon arrive when we may look to the Government to institute such a system. The plan is feasible of making it compulsory that every immigrant should register his trade or profession on landing in South Africa, and in the case of electricians should be placed in direct communication with the local secretary of the union, who should record details of the applicant's qualifications, &c. It is unnecessary for me to point out the damage that is done by the presence in this country of numbers of incompetent and inexperienced men."

Siloxicon and Carborundum.—Mr. E. G. Acheson, who discovered the process for making carborundum, as well as that for making siloxicon, has furnished our Niagara Falls correspondent with further information about these products of the electric furnace:—In the descriptions of the new refractory substance, siloxicon, that have recently appeared in the newspapers, it has been stated that siloxicon is inoxidisable; but recent investigations have shown that this is not true. Siloxicon, while variable in composition, may be represented by the formula Si_2C_2O, and when it is heated to or above 2,674° F., in an atmosphere containing

a large amount of free oxygen, decomposition takes place, probably in accordance with the following equation:—

$$Si_2C_2O + 7O = 2SiO_2 + 2CO_2.$$

If the siloxicon be in the form of a brick or other moulded mass, the reaction occurs on the surface, producing a vitreous glaze, which, in most instances, is tinged light green from the presence of iron. In the absence of free oxygen, or in a reducing atmosphere, no such decomposition occurs, and the temperature may be raised to the point of the formation of carborundum, or, approximately, 5,000° F., before any change occurs; then it takes place, it is thought, in accordance with this equation:—

$$Si_2C_2O = SiC + Si + CO,$$

solid carborundum remaining, while the vapours of silicon and carbon monoxide are given off. It is interesting to note that after having discovered this oxidation of siloxicon, tests were made with carborundum, and it was found to be affected in a manner exactly similar to siloxicon—notwithstanding the fact that for more than 12 years it had been generally considered inoxidisable.

"Science Correspondence." — The correspondence classes in electrical and mechanical engineering, conducted by Prof. A. Jamieson, M.I.C.E., whose reputation as a teacher renders commendation on our part superfluous, should be of great assistance to students who are unable to attend oral classes. Particulars will be found in our advertisement columns.

Ramsgate Tramcar Accident.—On Wednesday Major Von Donop held a Board of Trade Inquiry into the accident which occurred last week. Evidence was given by the drivers of both cars, and one of the conductors, and by Mr. Humphries, the company's engineer. We shall make further reference to the matter next week.

NEW COMPANIES REGISTERED.

Ekstromer Accumulator Co., Ltd. (78,175).—This company was registered on July 29th, with a capital of £25,000 in £1 shares, to acquire a patent provisionally accepted in the name of E. C. Ekstromer and another, numbered 7,773 of 1903, relating to improvements in accumulators and apparatus for preparing and applying the same, and any foreign patents to be granted in respect thereof, to adopt an agreement with E. C. Ekstromer, G. H. Lloyd and C. von Buch, and to carry on the business of manufacturers of and dealers in accumulators, dynamos and electrical apparatus generally. The first subscribers (each with one share) are:—J. S. S. Bogle, Palmerston House, E.C., chartered accountant; H. R. Oldfield, 13, Walbrook, E.C., solicitor; C. Vercoe, 102, Anerley Park, S.E., mechanical engineer; J. A. Scrivener, 20, Bucklersbury, E.C., secretary; J. P. Titterton, Craigowan, Boscombe Road, Southend, incorporated accountant; E. W. Ralph, Summerbank, Whitworth Road, South Norwood, clerk; and E. O. Andrewes, 14, Trebor Terrace, Shaftesbury Road, East Ham, clerk. No initial public issue. Table "A" mainly applies.

Timothy Morris, Ltd. (78,199).—This company was registered on July 30th, with a capital of £2,000 in £1 shares, to acquire the business of electrical engineers carried on by T. Morris and G. H. G. Jenkinson, at 173, Hockley Hill, Birmingham, as "Timothy Morris & Co.," and to carry on the same and the business of general engineers, manufacturing electricians, manufacturers of scientific apparatus, &c. The first subscribers (each with one share) are:—T. Morris, 100, Leonard Road, Handsworth, electrician; G. H. G. Jenkinson, 11, Lozells Street, Aston, manufacturer; A. C. Townsend, Linwood, Clarence Road, Four Oaks, Warwick, manufacturer; A. Tomkins, 39, Hockley Street, Birmingham, electrician; W. H. Harvey, 12, Sutton Street, Holloway Head, Birmingham, clerk; H. Tomkins, 365, Pershore Road, Birmingham, jeweller; and C. Tomkins, 65, Wills Street, Lozells, Birmingham, jeweller. No initial public issue. Registered without articles of association. The first directors are T. Morris, A. C. Townsend, A. Tomkins, W. H. Harvey, H. Tomkins and C. Tomkins.

Column Printing Co., Ltd. (78,207.)—This company was registered on July 31st, with a capital of £10,000 in £1 shares, to acquire the business of the Column Printing Telegraph Syndicate, Ltd., to adopt an agreement with the said syndicate and G. A. Robertson, to erect wires and apparatus for transmitting news (especially between persons in the same district), to act as newsagents, advertising agents and printers, &c. The first subscribers (each with one share) are:—C. J. Smith, 6, Mincing Lane, E.C., solicitor; J. Moore, 26, Nightingale Gardens, Clapham, journalist; W. P. Forbes, The Chilterns, Wanstead, advertising manager; G. F. Turner, 99, Alexandra Road, N., telegraphist; J. Lanyon, 25, Winterwell Road, Brixton, S.W., secretary; E. von Bibra, 29, Great Tower Street, E.C., restaurateur; J. A. Moore, 30, Felday Road, Lewisham, journalist. No initial public issue. The first directors are J. Moore, W. P. T. Forbes and J. H. Harris; qualification £100; remuneration as fixed by the company; registered office, 5, New Bridge Street, E.C.

South Western Electrical Co., Ltd. (78,230).—This company was registered on August 1st, with a capital of £5,000 in £1 shares, to carry on the business of electrical engineers, contractors, merchants, &c. The first subscribers (each with one share) are:—R. Cross, 39, Devonshire Hill, Hampstead, clerk; Miss R. Neale, 31, Pepys Road, Wimbledon; Mrs. J. Neale, 31, Pepys Road, Wimbledon; G. Neale, 2, Palace Terrace, Fulham, S.W., electrician; J. Fuller, 11a, Kingswood Terrace, Fulham, S.W., electrician; W. A. Dyer, 6, Elm Grove Road, Barnes, S.W., electrician; and W. Whillans, 178, New King's Road, Fulham, mechanic. Minimum cash subscription, £50. The number of directors is not to be less than two nor more than three. The first are G. Neale and C. E. Peczenik. Qualification £10. Remuneration of managing director £200 per annum, others £150 per annum.

ELECTRICITY SUPPLY ACCOUNTS.

Metropolitan Borough of Stepney Electricity Accounts.

The third annual report of the Stepney Electrical Department indicates the rapid progress which may be obtained under a system of moderate charges. With the low average prices obtained here, practically the lowest in the metropolitan area, which are attributed to the rigid use of the maximum demand system, with a high initial price and low prices afterwards, it is satisfactory to note that a surplus of £7,000 has been earned during the second and third years of running. Next year the department will have to meet its first instalment of sinking fund—capital repayment having been suspended during the first three years' working—and although the profits will be correspondingly diminished, nevertheless, if they maintain their present rate of increase, a handsome surplus should result.

The capacity of plant installed is now 1,220 kw., and the charges are for light, power and heat, 8d. per B.T.U. for the first hour, and 1d. afterwards. Mr. W. C. P. Tapper is the borough electrical engineer.

General Statement.

For year ending March 31st—	1902.	1903.	Inc.
Total capital expended	£114,890	£153,291	£38,401
Units sold—			
Private lighting	724,537	1,321,353	596,816
Public „	283,500	437,996	154,496
Total units sold	1,008,037	1,759,349	751,312
Equivalent number of 8-c.p. lamps connected	33,146	58,314	25,168
Number of public lamps	95 arcs 13 inc.	170 arcs 19 inc.	75 arcs 6 inc.
Maximum load in kw.	506	952	446
Revenue Account. Gross revenue ...	£10,639	£18,518	£8,149
„ expenditure ...	£5,158	£9,018	£3,860
„ profit	£5,211	£9,500	£4,289
Average price obtained—			
Private lighting	2·73d.	2·75d.	·02d.
Public „	1·62d.	1·60d.	—·02d.

Revenue Statement.

	1902. Gross.	1902. Per unit.	1903. Gross.	1903. Per unit.	Inc.
Sale of energy	£10,139	2·42d.	£18,049	2·46d.	·04d.
Meter rents, &c. ...	182	·05d.	265	·04d.	—·01d.
Sundry receipts ...	48	·01d.	204	·03d.	·02d.
Gross revenue ...	£10,369	2·48d.	£18,518	2·53d.	·05d.

Working Expenses.

	1902. Gross.	1902. Per unit.	1903. Gross.	1903. Per unit.	Inc.
Coal	£989	·24d.	£2,710	·37d.	·13d.
Steam from destructor	1,086	·26d.	£2,034	·28d.	·02d.
Oil, waste, water and engine-room stores	182	·04d.	328	·04d.	·00d.
Salaries and wages incurred in generation and distribution ..	732	·17d.	1,182	·16d.	—·01d.
Repairs and maintenance of buildings, machinery, mains, &c. ..	423	·10d.	770	·11d.	·01d.
Works and distribution costs	£3,412	·81d.	£7,024	·96d.	·15d.
Rent, rates and taxes	307	·08d.	292	·04d.	—·04d.
Management expenses, salaries of engineer, and clerical staff ..	1,096	·26d.	1,341	·18d.	—·08d.
General expenses, stationery, printing, law and insurance ..	343	·08d.	361	·05d.	—·03d.
Total works cost	£5,158	1·23d.	£9,018	1·23d.	·00d.

The works costs are stationary—despite a considerable increase in the cost of fuel—largely accounted for by the fact that the destructor department charged ·5d. per unit generated by their steam, as against, ·3d. per unit in the preceding year,

Profit Statement.

	1902.	1903.
Interest on loans	£2,957	£3,808
Instalment of principal	117	121
Cost of temporary building written off ...	102	426
Balance being net profit	2,034	5,145
Gross profit	£5,210	£9,500

The surplus of the two years ending March, 1902 and 1903 amounting to £7,179, was allocated as follows:—

To deficiency on first 15 months' working ...	£2,743
To appropriation account:—	
Writing off sundry items of capital account ...	2,833
To amount carried to reserve—to meet loan repayments and renewals	1,000
To amount carried to reserve for general depreciation	603
	£7,179

Barnsley Municipal Electricity Supply.

The returns of the Barnsley undertaking for the third complete year, show that very substantial progress has been made in the matter of output.

The special features of the year's work are the introduction of electric traction on the local tramways, which, since November last, has increased the output by 110,748 units; and the improvements in other branches of supply, which also show a large increase on the previous year of some 140,000 units.

The improvements in works costs (by about ¼d. per unit), are, unfortunately, minimised through extensive alterations to plant, necessitated by the tramway supply, being charged to revenue.

The results are, however, exceedingly creditable to the late engineer, Mr. S. E. Bastow, and it is very satisfactory to know that the committee recognise the policy of providing a cheap supply and otherwise encouraging consumers during the early years as the true means of success.

The prices charged are:—For private lighting, 4d. per unit, flat rate, or, as an alternative, on the maximum demand system, 7d. and 2d. per B.T.U. up to 10,000; 7d. and 1d. above that amount. Power and traction, 1½d. per unit, and in the latter case with discounts.

GENERAL STATEMENT.

Year ending March 31st—	1903.	1902.
Total capital expended	£54,454	£45,843
Number of units sold	556,923	304,415
Equivalent number of 8-c.p. lamps connected	31,967	22,183
Public arc lamps	36 arc, 85 incd.	27 arc
H.P. of motors connected	305	190
Maximum load in kw.	645	—
Revenue Account. Gross revenue	£6,585	£4,587
" expenditure	£3,247	£2,074
" profit	£3,338	£2,513
Average price obtained private lighting	3·14d.	3·54d.
" " " traction	1·5d.	—

REVENUE STATEMENT.

	Gross.	Per unit.
By sale of energy	£6,510	2·80d.
Sundries	75	·03d.
Gross revenue	£6,585	2·83d.

WORKING EXPENSES.

	Gross.	Per unit.
Coal and other fuel	£933	·40d.
Oil, waste, water and engine room stores	211	·09d.
Salaries and wages incurred in generation and distribution	566	·24d.
Repairs and maintenance of buildings, machinery, plant, &c.	449	·19d.
Works and distribution costs	—	·92d.
Rent, rates and taxes	613	·26d.
Management expenses	319	·14d.
General establishment charges, printing, stationery, insurance	117	·05d.
Special charges	39	·02d.
Total works costs	£3,247	1·39d.

PROFIT STATEMENT.

To interest on loans	£1,718
To sinking fund	1,329
To net profit on year's working	291
Gross profit	£3,338

On the year's working a gross profit of £3,338 was made; and, after meeting financial charges, a net profit of £291 remains, as compared with £116 in the previous year.

CITY NOTES.

Primitiva Gas and Electric Lighting Co. of Buenos Ayres.

A MEETING of debenture holders was held on 12th inst. to consider the agreement between the company and the Deutsch Uebersceishe Elektricitäts Gesellschaft for the purchase of the electrical portion of the company's undertaking. The German company is to pay the company £15,000 every six months for a period of 41 years, this being calculated to redeem the whole of the debentures and to leave a profit for the company. The resolutions authorising the transfer of the business were passed.

London Electric Supply Corporation.—The directors have declared an interim dividend for the half-year ended June 30th last at the rate of 6 per cent. per annum on the preference shares.

W. T. Henley's Telegraph Works Co.—An interim dividend at the rate of 12 per cent. per annum for the half-year ending June 30th, 1903, will be paid on the ordinary shares of this company on September 1st next. The half-year's dividend on the preference shares, at the rate of 4½ per cent. per annum, will also be paid on the share date as usual.

Blackheath and Greenwich District Electric Light Co.—The directors have resolved that an interim dividend at the rate of 7 per cent. per annum be paid upon the cumulative preference shares for the half year ended June 30th, 1903.

Imperial Tramways Co.—For the half-year ended June 30th last, the directors have declared an interim dividend on the £10 ordinary shares of 8 per cent. per annum. The dividend warrants will be payable on and after the 20th inst.

STOCKS AND SHARES.

Wednesday Evening.

CONTINUED shrinkage of values in the Consol market is beginning to arouse sentiments of uneasiness in the ranks of investors, and the movements of the Funds are watched with an unusual amount of interest. The mere fact that Consols fell day after day for no more ostensible reason than the bald one furnished by politics was, of course, a disquieting influence, and up to the time of writing a merely trifling indication of improvement has made itself felt. In the railway market the feature this week is the flatness of the electrical stocks, felt most acutely in the case of the Central London varieties. Electric Supply shares and Debentures, however, keep a hard market, while the telegraph department is scarcely cognisant of any effect produced by the fearful cyclone in Jamaica.

City and South London stock has retrograded still further towards that figure of 55, at which it was suggested it would be worth buying. The fall, however, was checked by the publication of a better traffic than had been looked for. Considering that the take compares with one that came at a time when London was busily moving about from place to place on account of the Coronation, the decrease is not at all bad. The Central London traffic for the week showed a decline of £1,130, but, in our opinion, a great deal too much is being made of the effect of the French accident. Nobody attributed the London and North-Western decrease of £11,000 to this cause, and, as a matter of fact, nearly all the chief lines showed up badly against the "Coronation traffics" of last year. Waterloo and City stock has barely moved, allowing for the dividend, but Metropolitan and Metropolitan District stock remain weak. It is estimated by some that the immediate loss to the Paris Metropolitan Railway, by reason of the recent holocaust, will not be under 5,000,000 frs., or, say, £200,000 sterling. Without doubt the travelling public has been painfully personally shocked by the accident, but it may be doubted whether the memory of the fire will exert any permanently maleficent influence over the companies' receipts. By the way, the whole of the electric installation of the Nile Valley Co., in Egypt, is said to have been destroyed by a destructive fire which occurred the other day.

The traction market, as a whole, is steady, no change taking place in British Electrics or London United Tramways issues. The London United's dividend at the rate of 8 per cent. is followed by the announcement of a similar distribution on Imperial Tramways shares. Cape Electrics at 2 are dullest, although the July receipts are £6,200 in excess of the expenses. A firmer tone has been developed by Anglo-Argentines, which mark 4⅝, and business is being done in Buenos Ayres and Belgrano Ordinary, and "B" Preference at 2½ and 5 respectively.

What changes there are to chronicle in the electrical supply list have the dividend deductions for their reason. Several shares are *ex*, and unchanged, too. The anxiety to buy the best class stock remains, and there are two or three rises in the Debenture list. Blackheath and Greenwich Preference will receive their 7 per cent. dividend, but the price of the Ordinary is unaffected, and no change followed the declaration of a 6 per cent. dividend upon the Preference Shares of the London Electric Supply Corporation. Hove shares at 8 are 10s. easier.

Henley's showed a disposition to harden upon their recently-announced 12 per cent. dividend for the Ordinary, but the only quotable alteration in this section is a rise of a point in British Aluminium Debenture stock. Marconi shares kept astonishingly quiet upon the news that a passenger crossing the Atlantic in one ship had been able to wireless-telegraphically borrow a ten-pound note from his mother, who sailed in another ship 50 miles away. The system surely deserves attention from the fraternity who live "without the law," as the Recessional says.

In view of the continued excitement in the American railroad market, it is rather surprising that the Anglo-American telegraph list is so stagnant. Anglo "B" has fallen 1 per cent., the group otherwise exhibiting no change. Nor is the Eastern division any more lively. Eastern Ordinary stock is marked down 4, but 3½ of that represents the dividend and bonus. West India and Panama Second Preference are ½ easier, possibly in connection with the fearful cyclone in Jamaica. The unfortunate colony had expended nearly £20,000 upon telegraphs, a good part of which is now almost dead loss owing to the ravages of the storm. Indo-European shares are rendered a shade harder by the quotation narrowing towards the upper figure, and Telegraph Constructions maintain their advance of last week. The issues of the Globe and Submarine Trust undertakings have passed a quiet week, while in the Telephone section business is almost at a standstill, as may be gathered from the fact that none of the National varieties show any fluctuation.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Aug. 12th.	Closing Quotations Aug. 19th.	Business done week ended Aug. 19th, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	98 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2¼ — 3½	2¼ — 3½	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3½%	61s.	60/6	47 — 50	47 — 50	48	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	92 — 94	91 — 93	92⅜	91½
3,105,580	Do. do. do. Deferred	Stock	5s. %	2s.	1/-	8 — 8½	8 — 8½	8¼	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	6 %	4⅜ — 5½	4⅜ — 5½	..	..
13,333,300$	Commercial Cable	$100	8 %	8 %	8 %	150 —160	150 —160	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	92 — 95	92 — 95	94	92⅛
16,000	Cuba Telegraph	10	4½%	4 %	6½%	7 — 8	7 — 8	7⅛	7 7/16
6,000	Do. 10 % Pref.	10	..	..	..	17 — 18	17 — 18	17	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	2½ — 3½	2½ — 3½	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
90,000	Do. do. 4½ % Debs.	50	..	..	..	97 —101 %	97 —101 %	..	..
60,710£	Direct United States Cable	20	3½%	3½%	3½%	10 — 10¼	10 — 10⅜	10⅛	10 1/16
87,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	93 —101	99 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	128 —133	124 —129	127½	125
1,955,565	Do. 3½ % Pref. Stock	100	..	..	..	89 — 92	89 — 92	91½	..
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	105 —108	107½	106
300,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	12 — 12½	12 — 12½	12⅝	12
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	104 —107 xd	104 —107	..	..
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	100 —103	98 —101	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —103	100 —103 %	..	..
180,227	Globe Telegraph and Trust	10	5½%	5½%	..	9 — 9½	9 — 9½	9⅛	9
180,042	Do. do. 6 % Pref.	10	..	..	..	12¾ — 13⅛	12¾ — 13⅛	13 1/16	12 7/16
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	12½%	22 — 23	22 — 23	..	..
62,500£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	10%	35 — 39	36 — 39	38½	38
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	100 —104	100 —104	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	100 —102	100 —102	101½	101
1,966,667	Do. do. Def. Stock	100	..	..	4½%	79 — 81	79 — 81	79½	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5½	5 — 5½	5 1/16	..
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 — 98	96 — 98	97⅛	96
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	101 —103	101 —103	102⅜	102½
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6 %	⅛ — ⅜	⅛ — ⅜	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	5 %	..	6½ — 7½	6½ — 7½	..	..
3,803	Submarine Cables Trust	Cert.	..	..	..	116 —121	116 —121	..	..
58,000	United River Plate Telephone	5	7 %	7 %	7 %	5½ — 6	5½ — 6	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅞ — 5½	4⅞ — 5½	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	104 —107	104 —107	..	..
15,609	West African Telegraph, Shares	10	..	..	2 %	5 — 6	5 — 6	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	95 — 98	95 — 98	..	..
267,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	..	12 — 12½	12 — 12½	12⅞	12 3/16
75,600£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	100 —103	100 —103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	97 —100	97 —100	98	..
88,321	West India and Panama Telegraph	10	1½%	..	..	⅛ — ⅜	⅛ — ⅜	..	..
84,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6½ — 7	6½ — 7	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	4 — 5	3½ — 4½	3⅝	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,600	100	..	..	..	98 —101	98 —101	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	3 — 4	3 — 4	..	..
800,000£	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	77 — 82	78 — 84	..	..
100,000	British Electric Traction	10	9 %	9 %	8 %	11½ — 12	11½ — 12	11 1/16	..
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	11⅞ — 12½	11⅞ — 12½ xd	12⅝	11 15/16
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	122 —125	122 —125	124⅜	123¾
100,000	British Insulated and Helsby Cables	5	15 %	10 %	10 %	6¾ — 7⅛	6¾ — 7⅛	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅛ — 5⅜	5⅛ — 5⅜	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —106	102 —106	..	..
50,000	¶Brovett, Lindley & Co., Ord.	£1	8 %	Nil	..	9/— — 11/—	9/— — 11/—	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	Nil	¾ — 1½	¾ — 1½	1⅜	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	6 %	1 — 1½	1 — 1½	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	99 —102	99 —102	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	85 — 90	85 — 90	..	..
35,000	Callender's Cable Construction shares	5	15 %	20 %	15 %	11½ — 12½	11½ — 12½	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5½ — 5¾	5½ — 5¾	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	106 —110	106 —110	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	103 —106	98 —101 xd	102	98
494,093	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	102 —105	99 —102 xd	101¼	100½
494,993	Do. do. Def. do.	Stock	..	4 %	4 %	104 —107	101 —104	103	..
1,330,000	City and South London Railway	Stock	1¼%	2 %	3½%	61 — 63	58 — 60	60	58
85,000	Crompton & Co., Nos. 1 to 85,000	5	8 %	7½%	..	2 — 2½	2 — 2½xd	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	101 —105	101 —105	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	Nil	..	0 — ¼	0 — ¼	..	..
17,139	Do. do. "A" shares, 01—017,139	5	2½%	Nil	..	1½ — 2½	1½ — 2½	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	71 — 75	71 — 75	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	75 — 80	75 — 80	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1¼ — 1¾	1¼ — 1⅞	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	..	..	..	2½ — 3	2½ — 3	2 11/16	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	99 —102	99 —102	99	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	9½ — 10	9½ — 10	9⅝	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	99 —102	99 —102	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	14 — 15	14 — 15	..	..
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5 — 5½	5 — 5½	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	108 —112	108 —112	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18½ — 19½	18½ — 19½	18¾	..
800,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	1½%	1½%	5½ — 5¾	5½ — 5⅝	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10½ — 11	10½ — 10¾xd	..	..
87,350	Telegraph Construction and Maintenance	12	17½%	20 %	20 %	33 — 36	33 — 36	35½	34½
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	100 —103	100 —103	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3½%	97 —100	95 — 98 xd	..	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

National Electric Free Wiring, ¾—¾.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14¼—14¾.
Do. do. Pref. (£10 pd.), 10—10¼.

Bank rate of discount 3 per cent. (June 18 1903).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations Aug. 12th.	Closing Quotations Aug. 19th.	Business done week ended Aug. 19th, 1903. Highest.	Lowest
100,000	Blackheath and Greenwich Dist. Electric Light, Ord.	‡ 1	..	..	..	⅝— ⅞	⅝— ⅞	1 1/16	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	..	..	..	118 —121	118 —121	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000	5	6 %	8 %	8 %	10⅞— 11¼	10½— 11 xd	..	..
20,000	Do. do. 7 % Cum. Pref.	5	..	..	..	10¼— 10⅝	10¼— 10⅝xd	..	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	9 — 9½	9 — 9⅜	9⅜	..
70,000	Do. do. 4½% Cum. Pref.	5	..	..	..	5½— 6	5½— 6 xd	5⅞	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref.	5	..	..	..	4⅞— 5	4⅞— 5	4 15/16	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	104 —106	104 —106	105½	..
44,436	*Chelsea Electricity Supply, Ord.	5	5½%	4 %	4½%	5⅞— 6¼	5⅞— 6¼	..	..
150,000£	Do. do. % Deb. Stock Red.	Stock	..	..	..	107 —110	108 —111	110	109½
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	0 %	5 %	5 %	10⅞— 11¼	10⅞— 11¼	10⅝	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13 — 14	13 — 14	13½	..
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	121 —126	122 —127	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —105	102 —105	104½	104
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4 %	8 — 9	8 — 9	8⅝	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	..	..	..	11½— 12½	11½— 12½	12⅛	..
400,000£	Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red	..	..	..	..	109 —112	109 —112	..	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	6½— 7	6½— 7	6⅞	..
80,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6 — 6½	6 — 6½	6⅛	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock	100	..	..	..	106 —109	107 —110	108½	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	10 %	10½— 11½	10½— 11½	11½	11
90,000	Do. do. do. 4 % Debenture Stock	Stock	..	..	..	103 —106	103 —106	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	2 — 2⅛	2 — 2⅛	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5½— 6	5½— 6	..	..
250,000£	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	100 —102	100 —102	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6½%	7½%	17½— 18½	17 — 18 xd	17⅞	17⅜
220,000£	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	108 —112	108 —112	..	..
250,000£	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	97 —100	97 —100	98½	..
10,852	Notting Hill Electric Lighting	10	7 %	6 %	6 %	13 — 14	13 — 14	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15½— 16½	15½— 16½	..	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8 — 9 xd	8 — 9	..	..
150,000£	Do. do. do. 3½% Deb. Stock Red	100	..	..	..	98 —101	98 —101	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	2½%	3½— 3⅝	3½— 3⅝	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	1¼%	3⅝— 4¼	3½— 4¼	3⅝	3⅛
80,000	Urban Electric Supply, Ord.	5	..	..	..	5 — 5⅛	5 — 5⅛	5 1/16	..
80,000	Do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5⅛	5 — 5⅛	..	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	12½— 13⅛	12½— 13⅛	13⅛	13 1/16
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6⅛	6 — 6½	..	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, August 19th.

CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a ,, ,,	per ton	£30	..
a Bleaching powder	per ton	£4 10	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£13	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£19	..
a Lead, Nitrate	per ton	£24	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks	per lb.	3d.	..
a ,, Caustic (75/80%)	per ton	£24	..
a ,, Bisulphate	per ton	£35	..
a Shellac	per cwt.	160/-	10/- inc.
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 5	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	..
a ,, Crystals	per ton	£8	..
a ,, Bichromate, casks	per lb.	2¼d.	..

METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£130	..
b ,, Wire, in ton lots	per ton	£168	..
b ,, Sheet, in ton lots	per ton	£166	..
p Babbitt's metal ingots	per ton	£43 to £145	..
c Brass (rolled metal 2" to 12") basis	per lb.	7d.	⅛d. inc.
c ,, Tube (brazed)	per lb.	8¾d	⅛d. inc.
c ,, ,, (solid drawn)	per lb.	7⅞d.	⅛d. inc.
c ,, Wire, basis	per lb.	7⅛d.	⅛d. inc.
c Copper Tubes (brazed)	per lb.	9¼d.	⅛d. inc.
c ,, ,, (solid drawn)	per lb.	9⅜d.	⅛d. inc.
g Copper Bars (best selected	per ton	£71	..

METALS, &c. (*continued*).		Latest Price.	Week's Inc. or Dec.
g Copper Sheet	per ton	£71	..
g ,, Rod	per ton	£71	..
e ,, (Electrolytic) Bars	per ton	£66	£2 inc.
e ,, ,, Sheets	per ton	£76	£2 inc.
e ,, ,, Rod	per ton	£68	£2 inc.
e ,, ,, H.C. Wire	per lb.	8d.	⅛d. inc.
f Ebonite Rod	per lb.	3/3	..
f ,, Sheet	per lb.	3/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	8/-	..
h India-rubber, Para fine	per lb.	3/11 to 4/0¾	..
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	46/9	4d. inc.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8	per ton	£9 15	..
g Lead, English Ingot	per ton	£11 10 to £11 15	..
g ,, ,, Sheet	per ton	£11 15	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£8 10	..
d Mica (in original cases) small	per lb.	4d. to 1/6	..
d ,, ,, ,, medium	per lb.	2/6 to 3/9	..
d ,, ,, ,, large	per lb.	4/- to 7/9	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/2	..
o Platinum	per oz.	£4	..
p Silicium Bronze Wire	per lb.	10d. to 1/-	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£128 to £129	..
g ,, Foil	per lb.	1/8	..
n ,, Wire, Nos. 1 to 16	per lb.	1/7	..
p White Anti-friction Metals—"White Ant" brand	per ton	£42 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7½d.	..
j ,, 6 lea. Flax	per lb.	5½d.	..
j ,, 8 ply 10 lbs. Russian	per lb.	4 13/16d.	..
j ,, 10 lbs. Russian, single	per lb.	4½d.	..
j ,, 180 lbs. Jute rove	per ton	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£23 15	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* W. H. Hindley & Co. *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RECEIPTS.

	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
	Aberdeen	Aug. 15	1,372	+218	14,442	+ 1,713	10	—
	Birmingham	,, 15	4,818	+ 75	166,504	+ 7,709	—	—
	Bournemouth	,, 12	1,488	—	—	—	10½	—
	Blackburn	June 26	909	—286	11,668	+ 674	12½	+1½
	Blackpool	Aug. 13	2,514	— 9	21,642	+ 1,326	8½	—
	Blackpool and Fleetwood	,, 15	2,071	— 61	9,326	+ 677	7½	—
	Bolton	,, 9	1,948	+29	36,082	+ 5,103	25	—
	Bradford	,, 16	3 910	+ 479	77 009	+12,421	41	+4
	Brighton	,, 16	1,234	+171	82,854	—	6½	—
	Bristol	,, 14	4,977	—448	—	—	28	—
	Burnley	,, 15	924	+ 97	—	—	7½	—
British Elec. Trac. Co.	Barnsley District	,, 7	157	—	5,592	—	4½	—
British Elec. Trac. Co.	Devonport	,, 7	605	+ 12	13,185	+ 502	5	—
British Elec. Trac. Co.	Dudley—Stourbridge	,, 7	1,536	+246	25,922	+ 2,738	15½	—
British Elec. Trac. Co.	Gateshead	,, 7	1,014	+135	26,889	+ 4 348	10½	+ ½
British Elec. Trac. Co.	Gravesend—Northfleet	,, 7	470	+ 177	7,228	+ 177	8½	—
British Elec. Trac. Co.	Greenock—Pt. Glasgow	,, 7	636	+ 36	16,762	+ 1,500	7½	—
British Elec. Trac. Co.	Hartlepool	,, 7	443	+ 61	8,272	+ 480	6½	+2
British Elec. Trac. Co.	Kidderminster	,, 7	313	+ 28	4,104	+ 223	4½	—
British Elec. Trac. Co.	Merthyr	,, 7	276	+ 12	6,183	— 218	3	—
British Elec. Trac. Co.	Middleton	,, 7	373	+ 83	9,990	+ 1,156	8½	—
British Elec. Trac. Co.	Oldham—Ashton	,, 7	622	+ 44	17,794	+ 1,523	8	—
British Elec. Trac. Co.	Peterborough	,, 7	173	—	4,474	—	—	—
British Elec. Trac. Co.	Poole	,, 7	577	+115	9,175	+ 1,456	5½	—
British Elec. Trac. Co.	Potteries	,, 7	1,948	+ 58	48,752	+ 2,842	28½	—
British Elec. Trac. Co.	Rothesay	,, 7	347	+102	4,567	+ 1,573	2½	—
British Elec. Trac. Co.	Sheerness	,, 6	140	—	1,662	—	2½	—
British Elec. Trac. Co.	Southport	,, 7	533	+ 94	9,474	+ 1,577	5½	—
	South Staffordshire	Aug. 7	1,467	+478	27,186	+ 2,757	21½	—¾
	Swansea	,, 7	532	+ 31	16,131	+ 1,362	5½	—
	Taunton	,, 7	150	+ 31	1,877	— 106	1½	+1¼
	Tynemouth	,, 7	710	+121	9,700	+ 983	3½	—
	Weston-super-Mare	,, 5	442	— 40	3,280	— 302	2½	+2½
	Wolverhampton Dist.	,, 7	627	+134	13 317	+ 6,479	10½	+8
	Wrexham	,, 7	210	—	2,667	—	—	—
	Yorks. Woollen Dist.	,, 7	557	—	7,775	—	6	—
	Cardiff	,, 15	2,077	+419	89,999	+13,235	14	—
	Chatham & District Co.	,, 6	815	+160	15,357	+12,024	8·53	—
	Dover	,, 15	299	— 13	7,155	+ 102	3	—
	Dublin	,, 14	5 268	+ 34	34,745	+ 6,129	46	—
	East Ham	,, 17	715	+209	18,818	+ 4,407	6	+ ½
	Glasgow	,, 15	12,797	+355	146,303	+16,261	65	+10
	Hull	,, 15	1,845	+ 6	96,579	+ 1,718	11	+ 1
	Ilkeston	,, 12	194	—	—	—	4	—
	Isle of Thanet	,, 15	1,705	—184	20,785	— 361	10½	—
	Leeds	,, 15	5,724	+466	114,478	+ 6,867	41	—
	Liverpool	,, 8	11,762	+415	319,028	+11,446	101	+2½
	Manchester	,, 15	11,715	+6194	296,550	—	73	—
	Newcastle	,, 15	3,425	—	—	—	17	—
	Portsmouth	,, 15	2,573	— 386	—	—	29	—
	Salford	,, 17	3,817	+1250	75,613	+23,570	30	—
	Southampton	,, 13	1,270	—	—	—	9	—
	Sunderland	,, 16	1,404	+ 34	25,579	+ 1,092	20	+3
	Central London Railway	,, 15	5,539	—1130	44,491	— 1,609	6	—
	City and S. London Ry.	,, 16	2.332	- 890	17,204	— 2,292	6½	—
	Dublin and Lucan Rlwy.	,, 16	164	+ 32	1,029	+ 92	6½	—
	Liverpool Overhead Ry.	,, 16	1,647	+ 43	12,178	+ 710	6½	—

* Compared with the corresponding period of 1902.

INSTITUTION OF ELECTRICAL ENGINEERS.

(Calcutta Section.)

ON THE PRESERVATION OF INSTRUMENTS AND MACHINERY IN BENGAL.

By Paul Brühl, Member.

(*Paper read at Calcutta, March 27th*, 1903.)

The remarks I am going to make on the preservation and care of machinery and instruments are not only applicable to Bengal, but to hot and moist countries in general. But I mention Bengal in the heading of my paper, because my experiences on the subject have been gathered in this country during the last twenty years; it is, however, quite possible that some of my statements may have to undergo certain modifications when applied to places situated nearer to the sea, like Bombay or Madras. But then the paper is meant to elicit information on the subject matter from other members of our branch besides myself.

I shall classify my subject according to the adverse influences which men in charge of laboratories or central stations have to combat in this country. Those influences are mechanical, physical, chemical, and biological. They can, however, not always be separated from each other, and I may, therefore, be excused, if I do not always strictly adhere to my own division of the subject.

As we all know to our cost, a good deal of mechanical injury is often done, before the goods reach our hands. It is, of course, useless to expect that the treatment accorded by porters and dock labourers or railway servants in Europe, or by coolies out here, to cases containing scientific instruments will be in any way different from the treatment meted out to cases of cotton goods or bales of jute. They will be banged about, dropped from heights varying from a fraction of an inch to 20 or more feet, rolled down inclines and turned over and over regardless of any printed admonitions of the type of "This Side Up." I do not know whether railway porters and dock labourers are more considerate on the Continent than they are in other parts of our globe. Perhaps they are. At least that is what one would conclude from a printed label on a case which I received some time ago from a Berlin firm of scientific instrument makers. On the label there was a printed request—in German, be it remembered—addressed to "respected gentlemen," officials or otherwise, to kindly keep that side of the box with its face upwards. Now the first glimpse I got of that box was in the Calcutta Customs House at the moment when one of the "gentlemen" with dhoties round their loins and a blackened cloth round their heads was turning it over and over round any and every direction for an axis of revolution, until every side had had its chance of being "up." Hence the wisdom of the rule: "Do not expect any side of a packing case turned any way; do not address people in a language which they do not understand, and do not indulge in the vain hope that human beings who cannot read are likely to act according to printed directions!" I have seen some rather bad cases of breakage, but luckily for us we on this side of the globe are not quite as bad as our brethren of the western hemisphere, where the most expeditious, though perhaps not quite the cheapest method of breaking stones is to pack them in a strong box and send them by rail to the next town.

In any case we find ourselves face to face with certain unalterable conditions, and as practical politicians, we have to take the world as it is and not as we should wish it to be. Now to avoid breakage, notwithstanding the rough treatment that will most certainly be bestowed on the cases during transit, three points must be attended to. In the first place, instruments should in every case be designed so that they are able to stand with impunity the knocks they will with certainty get on their journey out to India; weaklings must not aspire to the honour of being explorers or pioneers.

To give some specific instances.

Ample and efficient provision should always be made for securing the coils of suspended coil galvanometers, the magnetic systems of Kelvin and Helmholtz galvanometers, and other loose or oscillating parts of instruments. There is absolutely no sense in the manufacturers fitting on the suspension, and not taking precautions to prevent the suspensions getting broken before the instruments reach their address. An ideal which designers ought to steadily keep before their mind's eye is one which Clark Fisher refers to in his book on the potentiometer: an instrument should be so designed that, provided it is properly packed, it should be possible "to throw it across the room with impunity, or even to send it by rail in the United States." Portability and security during transit is a condition which most instruments sent out to this country ought to satisfy.

In machines, sections which give rise to injurious stresses after casting, or such as create lines of weakness along which concussion is likely or certain to produce fracture, should be carefully avoided, and pins or bolts or screws which hold parts in position should be designed of a sufficient cross-section to prevent shearing taking place. Some time ago I received an electric motor with the insulation of the wires on one of the end faces of the armature scraped off and the wires partly cut into by some part of the frame. The cause of the mischief lay in a pin which had the function of keeping one of the shaft bearings in position having been sheared right through, probably in consequence of the case containing the motor having been dropped from a railway wagon or into a ship's hold and a trifling difference in the design of the bearing would have prevented the accident. It would be a good thing if every designer of instruments and machines manufactured for export made himself intimately acquainted with the special conditions of transport. Personally, I believe that, with proper design and proper packing, accidents to instruments need hardly ever occur except in the case of a railway collision.

This leads us into the domain of the packer.

Most of the larger firms of manufacturers of physical and chemical apparatus have evolved, on the basis of their own and other people's sad experiences, methods of packing which in the majority of cases prove fairly efficient. Of late years I have only rarely received articles in a broken condition; but then I make it a point to deal only with first-class firms. Very effective is a description of wood shavings, consisting of very thin, very long, and very narrow strips, which seem to be specially manufactured for the purposes of the packer.

It is self-evident that parts should never be lying loose in their box. One of the worst sins of commission on the part of a packer is to pack very heavy and bulky articles in the same case with delicate parts; and yet that is done again and again, as if the packer considered the heavy parts to be specially designed to triturate the delicate parts into a fine powder. All heavier parts should be tightly fastened down by screwed-on battens; and if it is found unavoidable to pack smaller articles in the same case with larger and heavier ones, they should be packed in separate small boxes. All this seems simple and self-evident; but unfortunately sufficient attention is not always paid to these details, and it is astonishing what thoughtless blunders are sometimes perpetrated by the packer.

As mercurial air-pumps are not beyond the ken of electrical engineers, it may be interesting to some of you to have mention made of a very efficient way of packing complex pieces of glass apparatus; and as regards fragility, some mercurial air-pumps certainly carry the palm. What I believe to be an absolutely safe way of packing such fragile pieces of apparatus is as follows:—A coarse network of square meshes of strong twine is stretched tightly across the inside of the packing case, being held in position by battens screwed against the sides of the case. The glass parts are then tied on to the net by means of strong thread, and cotton-wool or fine shavings are filled in between each tier of netting and the next one.

If a case containing fine instruments is to be piloted through the Customs House, and the case is to go through the somewhat severe ordeal of being opened in that delightful place, which, by the by, reminds me strongly of the Turkish War Office in Constantinople in some of its leading features, I should advise the victim to take a mistry with him, and provide himself with chisel, hammer, screwdriver, and nail-extractor, because the "cooper," who will otherwise be told off to open the case, will certainly open it in his own primitive way, but he will very likely open various contents at the same time.

To prevent persons whose thirst for knowledge is a large multiple of their actual knowledge from causing mechanical mischief to instruments, some makers box up the working parts of the instruments in such a way that access to them is practically impossible to anyone, except the maker, who is in possession of the key to the inmost mysteries of the construction. This plan does not work well in this country, from where it is a far cry to Europe, and where skilled and experienced mechanics endowed with common sense are few and far between. Matters *will* go wrong even in the best managed concern, and in the case of something *going* wrong, accessibility is a great desideratum. There is much less chance of serious injury being done to an instrument if all its parts are easily accessible, if soldered joints are dispensed with as much as possible, and if the design is along simple and open lines. If protection from undue interference is desirable, that can be provided in many cases by housing the instrument in a lockable glazed case.

Leaving one of the most destructive of the mechanical agencies—dust and grit—to be dealt with later on, we proceed to take up, in the second place and conjointly, the physical and chemical influences which act injuriously on instruments and machinery. It does not appear to me that the higher temperatures of the tropics and sub-tropics, taken by themselves, play a very important part in connection with our subject. It is doubtful whether any dynamo has ever been injured by being run under full load, although the starting temperature of armature and field coils has been, say, 100° or even 110° F., and therefore 20° or 30° higher than the initial temperature would be in England. There are only a few instances known to me of the higher Indian temperatures causing temporary or permanent trouble. One case occurred with one of Lord Kelvin's current balances, in which, during the first hot weather, the coils commenced to sweat out some of their paraffin, causing the movable coils to stick. A small quantity of the more fusible paraffin having oozed out, the remainder having a higher point of fusion remained behind in the solid state, and the balance has been in first-class working order ever since. But it is advisable for manufacturers of apparatus in which paraffin is used for insulating certain parts, to use only paraffin of high-melting points in apparatus meant to be used in tropical countries.

It is possible that the higher temperatures of the tropics have something to do with the dust which may happen to lie for some time on varnished parts of apparatus, becoming ingrained in the coat of varnish and spoiling its appearance for good. The only remedy in this case is frequent dusting and keeping the apparatus under cover when not in use.

It is different with higher temperatures acting in conjunction with chemical agents; in this case the influence of temperature ceases to be negligibly small. It is well known that the time-rates at which chemical actions proceed are not only generally speaking

functions of the temperatures at which they happen to take place, but they are often rapidly increasing functions of the temperatures and are therefore frequently represented by curves which at first are nearly horizontal, but beyond a certain point curve rapidly upwards. Unfortunately hardly any precise data are available on the relation between temperatures and the time-rates at which such chemical actions take place as the rusting of iron, the formation of verdigris, the action of nitre on various substances interesting to the electrical engineer, the chemical changes which lubricating oil and allied substances undergo in contact with the atmosphere, the action of carbonic acid on various silicates, the action of atmospheric ozone. Indeed we have here quite a formidable array of interesting problems which should gladden the heart of the Indian Research scholar.

Leaving aside the effect of heat, of light, of atmospheric electricity, we shall refer in what follows to a few points in connection with chemical influence taken by themselves.

We all know that the process of rusting proceeds with astonishing rapidity in this country; it does not take things—and sometimes even persons—long to get rusty. Handling a clean and bright piece of iron in the rainy season causes the almost instantaneous appearance of permanent finger-marks. Although the process of blueing protects iron and steel parts to some extent, its influence does not last very long, and rust makes its appearance on the blued articles sooner or later, usually sooner. Vaseline prevents rust, but after some time becomes converted into an unsightly dirty yellow film of leathery consistency. For several years past I have been using the Vacuum Co.'s spindle oil as a protecting covering of all bare metal parts, including blued steel articles. It is true that even spindle oil changes its originally light yellow colour into red-brown in the course of time; but a repeated application of the oil by means of a brush—a camel's hair brush for delicate parts—after wiping off the old oil, keeps instruments in first-class condition. What one commonly finds on opening cases recently arrived from Europe and examining their contents, is that most of the steel parts are attacked by rust. Among other things I remember once having received some Browne and Sharpe's micrometer gauges absolutely covered with a felt of rust notwithstanding the gauges being enclosed in silk-lined cases. Iron and steel articles do not stand the journey from Aden to Calcutta, especially if the journey is followed by a period of rest in the ship's hold or the Customs House godown. All this mischief can be avoided by thickly covering the steel parts with vaseline or a neutral mineral oil. Never mind if the silk-lining of a case gets a bit spoiled by the process. Of course, oils which contain even only a trace of free acid act like the very poison. One cannot be too careful, before preserving steel parts in kerosene oil, to test the oil for acidity; otherwise one may, after a short time, find the steel articles buried in a copious deposit of rust slime. Although one of the most excellent clearing agents for dirty iron parts of instruments and machines and, I may add, for hands soiled with dirty machine oil or brass stains, kerosene oil is very treacherous when used as a protective covering of bare metal parts.

(To be continued.)

INSTITUTION OF MECHANICAL ENGINEERS.—LEEDS CONFERENCE.

NOTES ON HIGH-SPEED TOOL STEELS.

By H. H. Supple, of New York.

(Abstract.)

The author gives officially verified data as to the use of high-speed tool steels in the works of the Union Pacific Railroad, at Omaha, Nebraska.

The steels are of the Mushet air-hardening variety, but a much higher temperature is used in the hardening process. The method of treatment consists in heating the tool up to about 2,000° F., then cooling rapidly down to 1,700° F. in a lead bath, and then slowly in air or lime. The steels contain both chromium and tungsten in varying proportions, as well as molybdenum.

Steel when treated in this way will maintain a cutting edge, even when operated at speeds producing a red heat—in fact, it does not give good results unless worked at a high speed and temperature.

These tools should be used only for roughing purposes; the great economy resulting from their use lies in the fact that the roughing-down of forgings can be done more rapidly by machining than by forging.

Photographic reproductions of turnings are given at the end of the paper. The first shows small chips turned from a car-wheel with ordinary tool steel at 8 ft. per minute, removing 8 lbs. per hour. The second shows a thick turning about 5 in. long. This was turned off a loco. tire with Midvale tool steel at a speed of 24 ft. per minute, removing 120 lbs. an hour; and the third, a very thick turning about 2½ in. long, turned with the same kind of steel, at the rate of 18 ft. per min., removing 450 lbs. of metal an hour. The latter was too much for the strength of the lathe, although the tool showed no signs of distress.

We have tabulated the principal results below:—

—	1	2	3	4	5	6	7	8
Machine tool ..	Lathe	Lathe	Lathe	Vertical boring mill.	Vertical boring mill.	Cylinder boring mill.	Driver lathe.	30-ft. planer
Material machined	Soft c.i.	Scrap iron.	Scrap iron.	Tire steel.	c.i.	Hard c.i.	Hard steel.	Scrap iron.
Speed of cut in ft. per min.	74	18	26	40	20	18	24	15
Depth of cut ..	½ in.	⅜ in.	½ in.	⅛ in.	13/32 in.	⅜ in.	⅜ in.	5/16 in.
Feed of cut ..	3/32 in.	1/16 in.	⅛ in.	⅛ in.	⅛ in.	⅛ in.	5/32 in.	¼ in.
Weight removed per hour	—	—	—	—	—	—	90	247-458
Electrical H.P. ..	—	—	—	—	—	11·7	17·25	23

The steel used in each case was "Novo tool steel," forged at high lemon colour, cooled slowly in air, reheated to white heat, till nose of tool begins to run, then cooled in steady air-blast or in oil, the latter giving better results.

A NEW FORM OF FRICTION CLUTCH.

By Prof. H. S. Hele-Shaw, LL.D., F.R.S.

(Abstract.)

The usual object of a friction clutch is to impart motion from a piece of running machinery to another piece of machinery at rest, thus differing from any ordinary form of coupling or from the jaw clutch. During the whole time that the two pieces of machinery are coming to one speed, work is being lost at the surfaces where the slipping takes place, and heating consequently occurs.

The four conditions involved in the problem of the friction clutch are:—

1. It must have sufficient gripping power.
2. Undue wearing of the surfaces must be avoided.
3. Provision must be made for dissipating the heat due to slipping.
4. Motion must be imparted without shock.

The various clutches in use may be classified as follows:—

1. The cone clutch, where considerable pressure is obtained between the surfaces by the wedge action of the cone.
2. Various forms of rim clutch, in which the action is obtained by means of levers.
3. Clutches with rings or segments expanding within a drum or annulus.
4. The brush clutch, in which wire brushes are thrust into a finely serrated or grooved plate.
5. The coil clutch, in which a coil of metal or wire rope with blocks is employed to give great gripping power.
6. The "Weston" clutch, in which the friction effect is produced by a number of circular discs connected alternately with the driving and driven machine.

Although some of the modifications of the above types are capable of transmitting considerable powers, no clutch has yet been designed to allow slipping to take place for more than a very short time without being seriously injured, even if the contact surfaces were not actually destroyed, by heating.

The author describes a form of clutch that he has devised, which permits of the rapid dissipation of heat, and may, therefore, be used as a variable-reduction speed gear. The fundamental feature of the design is the use of a number of corrugated plates or discs, which are alternately fixed to the driver and driven shafts as in a "Weston" clutch.

If two or more such plates are laid upon each other, portions of the frusta do not make contact with each other, and there is an air space left between the plates, as shown in fig. 1.

Fig. 1.—Pair of Plates, Showing Clearance Due to Corrugations.

The gripping power of a number of such discs fixed alternately to a driver and a driven shaft is very considerable, and depends to some extent on the angle of the cone. The increased grip as determined by tests with such a clutch over the flat disc type, cannot be accounted for by the ordinary laws of friction; nor can the striking differences between the gripping action of the two types when a lubricant is introduced be easily explained.

A large number of experiments with plates of different angles have been made, and a series of diagrams is given in the paper, graphically recording the results. The plates used in these experiments were 6 in. in diameter; the diameter across the V centres was 4½ in., and the angle of the V was 35°.

Fig. 2 shows how the space occupied by a nest of plates depends upon the angle of the corrugation. Thus, four plates, having a 30° angle, occupy the same space as six plates having a 50° angle. The four plates, however, give a better grip, allow freer circulation of liquid, and are more rigid.

The faces of the V are drilled to allow free circulation of the lubricant.

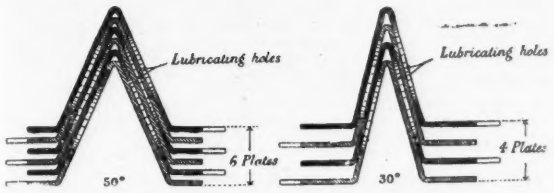


Fig. 2.—Circulation of Liquid with Varying Angles of Plates.

Several illustrations of open and closed clutches are given in the paper, fig. 3 showing the general arrangement of the plates.

An illustration is given of a clutch transmitting 80 H.P. at 60 r.p.m. For two hours a day the clutch must transmit only 30 H.P. (presumably at a lower speed) the main shaft running at its full speed of 60 r.p.m. A continuous flow of lubricant is maintained through the clutch by means of a rotary pump, driven by a band from the clutch case.

This clutch has been working at Messrs. Pilkington's glassworks, night and day, for five months, fulfilling every requirement satisfactorily.

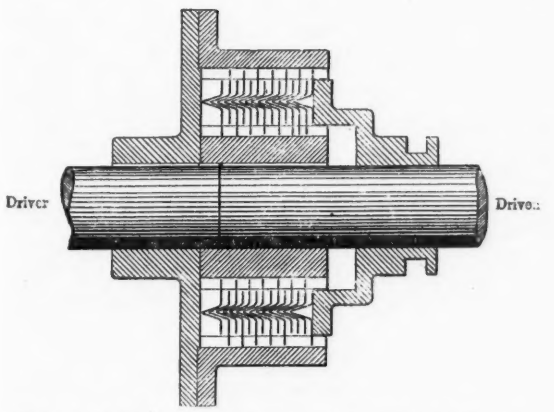


Fig. 3.—Ordinary Arrangement of Corrugated Plates.

Details of a 20 H.P., and a 1,000 H.P. reversing clutch are also shown, the former having been successfully applied to a motor launch built for His Majesty the King by Messrs. Thorneycroft.

Motor-cars have also been fitted with these clutches, by means of which a car having a full speed of 45 miles an hour may be driven at three or four miles an hour or even less; and after running for an hour or two under these conditions, the engine running at full speed, the clutch does not get hot.

It would appear from the above that, if this new clutch will do all that is claimed for it—and Prof. Hele-Shaw's name is a sufficient guarantee as to the accuracy of the tests—the problem of a change-speed gear has, to some extent, been solved. True, the reduction of speed necessarily means a reduction of power at the low speed, as the slipping of the clutch means loss, but there are many cases where the loss of power is not so important as the facility to readily vary the speed.

The author says "the main object of the change gear, which is to increase the power if necessary, is not attained, since the slipping of the clutch can only involve loss of power."

We cannot endorse this expression, nor can we believe that Prof. Shaw means quite what he says, for no gear can increase power, in the sense of giving out more power than is put into it. This would imply an efficiency of more than 100 per cent. The author's meaning is not obvious.

There are many motor applications in which a machine needs to be started up very slowly and gradually accelerated to full speed, such, for instance, as newspaper printing machines, callendering machines, centrifugal driers, and so on, a thing which is not easily accomplished electrically.

A motor starting against a load will not crawl round as desired, but will stand till sufficient resistance has been cut out to give it the necessary torque, when it will start off with a jerk and probably do some damage.

A satisfactory clutch which will permit of the load being gradually applied may solve the problem mechanically, which Ward-Leonard, the Bullock Co., and others have attempted by complicated electrical methods.

The clutch described seems to possess the necessary features for success, and the reversing gear type may prove useful in connection with turbine-driven steamers.

FUEL ECONOMY IN ELECTRIC STATIONS.

By H. McLaren.

This paper has been prepared by the author from the published figures of station costs. While the results given are a series of summed-up averages, they are not to be flouted. The author shows that the non-condensing stations do better as regards works cost per unit of energy than do condensing stations. One cannot help thinking in this connection that the method of carrying out condensing must be at fault. The author does not condemn condensing. On the contrary, he seems to have an inkling of the causes of the trouble. Probably owing to the flippant manner of regarding a vacuum of 15 in. which too often prevails, great expense is incurred in working condensing plant to no end except to waste fuel. Every effort should be made to secure air tightness, instead of depending on the heroic efforts of the independently-driven air pump, which does its best to compete with open joints and untarred porous cast pipes.

In some condensing stations the engines are being sucked round much of their time by the air pumps, which are probably far too large for their work. Naturally the author inclines to air pumps worked direct by their own engines, each main engine driving its own air pump. This system is good in that it forces attention to leakages and prevents the common and bad practice of keeping up a vacuum by increasing the speed of the independent air pump. The author refers to the guarantees for the Tooting tramway engines of 13¼ and 16 lbs. of steam per I.H.P.-hour when run non-condensing and condensing respectively. But such guarantee performances are of small account in practice. They are based on steady loads, and are of little value in actual service, and only good as showing probable piston and valve tightness. But most electric tramway engines are too large for their duty. They are almost invariably compound, and this alone makes them twice the size of a simple engine that would give the same maximum power.

The author considers piston valves to be very faulty in use, passing a lot of steam direct to the condenser unsuspected and unknown. He points out the defects of the chain grate stoker, the abuse of forced draught, the bare grates, the waste of steam jets, and generally gives the impression that the electrical spigot is cared for at the cost of the heat department bung-hole. Station engineers should begin with steam and add to it electricity, but it is common knowledge that the average town alderman or councillor will pass over a certificated marine engineer in favour of a two years' electrical student, instead of putting an experienced engineer in charge with an electrical colleague. A man of the double capacity is not always to be found, but the greatest losses are made in the steam department, and this ought to be in competent hands. It very rarely is, however; hence such papers as this before us, which ought to be pondered upon by all station engineers.

PRIVATE BILL LEGISLATION OF THE PAST SESSION.

[BY OUR PARLIAMENTARY CORRESPONDENT.]

With the rush of Parliamentary Agents at the beginning of the session depositing plans of proposed tube railways, it looked as if the Parliamentary session just closed would be a very exciting one, so far as promoters, at all events, were concerned, but the Government suddenly awakened to the fact that London was being parcelled out with little or no regard to its treatment as a whole, and the result of this awakening was the appointment of the Royal Commission on London Locomotion. This Commission has sat a good many times and has most exhaustively inquired into what has been done in the past in the way of transport facilities for Londoners, but so far little evidence has been taken as to what may be done in the future. Owing to the appointment of the Commission the majority of the tube railway Bills presented were ordered to be suspended pending the report of the Committee. Such suspended Bills and their proposed capital were as follows:—

City and Crystal Palace	£3,450,000
Central London (new lines)	3,150,000
Clapham Junction and Marble Arch (1)	1,500,000
Do. (2)	2,040,000
North-West London Railway	700,000
Great Northern, Piccadilly and Brompton (new lines and extension)	2,343,178

While, however, the above Bills were suspended, some other tube Bills were allowed to proceed, and all but one were passed. The

defeated Bill was the City and North-East Suburban Electric Railway Bill, which sought to construct a railway at an estimated cost of £4,217,052. All seemed to be going well until the financial question was reached, when the promoters could not give a guarantee that the capital would be found, and the Committee promptly threw out the Bill. The City and South London Railway Co. have got their Bill, which will enable them to extend their line at the Islington end, and to carry out the City and Brixton undertaking. Two other Bills which have gone through are the Charing Cross, Euston and Hampstead Railway, and the Watford and Edgeware Railway. If these schemes are carried out, and the already authorised line from Golder's Green to Edgeware is constructed, another route will be opened between Watford and Charing Cross. The Great Northern and City Railway Co. have got further power to raise capital, and further capital powers are obtained by the Great Northern, Piccadilly and Brompton Railway under its Various Powers Bill. The Baker Street and Waterloo Railway have obtained two Bills, by one of which the undertaking becomes a part of what is known as the Yerkes group, and by the other the time for the completion of the undertaking is extended. The only point of much interest which has arisen on these Bills has been the attempts made by the London County Council to enforce more workmen's trains. On the whole that body has been successful, but the Lords Committee refused to look upon the Charing Cross, Euston and Hampstead Railway, and the Hampstead and Edgeware Railway, as one undertaking, although they will be worked together, and the project, therefore, to make a 2d. workmen's fare right through, did not come off. The Metropolitan District Railway, which is also bound up in the "Yerkes" group obtained their Various Powers Bill, which will allow of important developments, for the company will be now enabled to construct two short pieces of railway between Mark Lane and the Minories, giving the Whitechapel and Bow Railway and the London, Tilbury and Southend Railway access to the line. Their other Bill, which sought to empower the construction of certain tube railways, was hung up pending the report of the Royal Commission.

The session has been notable owing to the powers taken by several of the great trunk lines to electrify their lines. Thus the Great Eastern Railway, the London, Brighton and South Coast Railway, the South-Eastern and London, Chatham and Dover Railways, the Seaforth and Sefton Junction Railway, and the Taff Vale Railway, have all now got Parliament to give them the necessary powers to use electric traction. The promoters of the Coventry and Arley Railway, who also proposed to use electricity, failed to get the Committee to pass the scheme, while the ambitious scheme to construct an electric railway between London and Brighton at an estimated cost of £4 394,927, was dropped very early in the session.

Since the South Wales Electric Power Bill was carried through Parliament some years ago the number of electric power schemes have been steadily increasing each year, and this session no fewer than nine Bills were introduced. Of these the Antrim, Down, Armagh and Belfast Bill was dropped, and the Cleveland and Durham Bill was only an amendment of the company's Act of 1901, Two were Scotch Bills, viz., the Scottish Central Electric Power Bill, which incorporates a company to supply Linlithgow and Clackmannon and portions of Stirling and Dumbarton; and the Fife Electric Power Bill, which incorporates a company to supply the county of Fife. The other Bills are the Carmarthenshire Electric Power Bill; the North-Western Electricity and Power Gas, which sought to supply the whole of Cheshire, parts of Staffordshire, Flint and Denbigh; the Shropshire, Worcestershire and East Denbighshire Electric Power Bill; and the Somersetshire and District Electric Power. The consideration of the last-named Bill was significant in one particular; inasmuch as the attempt on the part of the Bristol Corporation to set a ring fence around the city in which they have at present the monopoly of the electric supply, was only partially successful; and the company will now be enabled to supply power within the City if the local authority cannot within a reasonable time and at a reasonable price do it themselves. This is somewhat of a departure from the practice which had grown up of excluding the big municipalities from the operations of power Bills, and probably the recent agitation on the question of municipal trading has not been without its effect. The North-Eastern Electricity and Power Gas Bill was a novel proposal, inasmuch as it was the first proposal brought before Parliament to combine the supply of electricity and Mond gas. The promoters were only partially successful, as the Committee considered that in scheduling such a large area they had bitten off a little more than they could chew, and accordingly Cheshire was deleted from the area.

Tramway schemes were more numerous than ever. Fifty-four private Bills dealing with tramways were promoted, and of these 23 emanated from Borough Councils or other local authorities. There were also two Confirmation Bills, which confirmed 12 orders granted by the Board of Trade. Before the session had far advanced the following Bills were dropped:—Hamilton, Motherwell and Wishaw Tramways, the Luton, Dunstable and District Tramways, the Macclesfield and District Electric Tramways, the North Cheshire Tramways, Belfast Street Tramways, and Hove Corporation Tramways. The London County Council, as usual, went in for a big Bill, but owing to the difficulty of obtaining consents from the Borough Councils the final results were very meagre, for out of 22 miles odd proposed only about 3½ miles were obtained. In a number of cases the Council itself decided not to go on with the proposals owing to the refusal of the local authorities to contribute one-third of the net cost of the street widenings required. The only important line the Council obtained was to make a tramway from Harlesden to Hammersmith Broadway. Of the other great Corporations, Manchester, Bradford, Salford, Sheffield, West Ham and Wigan asked for little, and obtained it. South Shields, Worthing and Sutton Coldfield each got about 8 miles authorised; Exeter 6 miles, and Rochester 5 miles. In the case of Brighton, the Bill of the Corporation was considerably mutilated, and the old question of electrolysis was raised, which resulted in the Lords Committee inserting a stronger clause than the model clause of the Board of Trade to protect the local gas company. A great fight took place over the Plymouth Corporation Bill, and after the preamble had been proved, so far as the tramways were concerned, the Corporation refused to submit to having a clause inserted providing for a Government audit of the accounts, and withdrew their Bill. The result of this action will be somewhat interesting to watch, because one of the proposals of the Corporation was to carry a tramway to Crownhill, outside the borough, and it was stated before the House of Commons Committee that Devonport was also promoting a scheme to Crownhill before the Light Railway Commissioners, but that the Commissioners had decided to wait until Parliament had considered the matter before giving their decision.

The South Shields Corporation promoted a Bill for the construction of electric tramways, and were strongly opposed by the British Electric Traction Co., who had a rival Bill. In the course of the inquiry it was admitted by one of the Corporation witnesses that the Corporation had offered "free current" to the ratepayers on the principal of throwing a sprat to catch a mackerel. While agreeing to pass the preamble of the Bill, Colonel Bowles's Select Committee inserted a clause similar to that known as the Bermondsey clause in respect of electric lighting undertakings, which provides that a balance-sheet shall be drawn up at the beginning of each year and the fares fixed so that the revenue shall meet the estimated expenditure.

To a company naturally fell the task of proposing something new, and this cropped up in the Stroud, District and Cheltenham Tramways Bill, where a newly incorporated company propose to run motor-cars by means of the overhead trolley wires without running them on rails. The company got their Bill. The two Manchester Southern Tramways Bills (Cheshire and Lancashire) were amalgamated, and a number of tramways authorised. By the Mid-Yorkshire Tramways Bill about 18 miles of tramway were authorised, and by the provisions of the Birmingham District Tramways Bill, a more efficient tramway service around Birmingham will be brought about. The British Electric Traction Co. were successful in getting through their Croydon and District Extension Bill, the Hove, Worthing and District Tramways Bill, and the Wellingborough and District Tramroads Bill, but failed to get the Committee to agree to the South Shields, Sunderland and District Tramways. The Chatham and District Light Railways Co. succeeded in obtaining some important extensions, and the London United Tramways Co. were content to obtain powers for street widenings at a cost of £80,172. In this connection, apparently the whole of the street widenings required for the tramways of the company, are paid for by the company and charged to capital account, as compared with only one-third charged by the London County Council to the capital account of its tramway undertaking when a street requires widening for tramway purposes. A most important scheme was that set forth in the Nottinghamshire and Derbyshire Tramway Bill, it being to connect Nottingham to Derby by a tramway. The opposition was, however, too strong to be overcome, and the Bill was amended so as to make a line from Nottingham to Alfreton, from Belper to Alfreton, and on the north to Mansfield. A very important decision was come to in the case of the South Lancashire Tramways Bill, where the St. Helens Corporation objected to the company having running powers over the lines in that town which were owned by the Corporation, but leased to a company, which company was willing to give the necessary powers. It was pointed out that if the running powers were allowed it would give direct communication between the Liverpool Docks and the towns of South Lancashire over the Liverpool Corporation tramways, the Prescot and Liverpool line, the St. Helens tramways, and the South Lancashire tramways. The Lords Committee decided to grant running powers for the period of the lease on arbitration terms. Another important scheme sanctioned was the Preston and Horwich Tramways Bill, which will connect the two towns, a distance of over 20 miles, and in addition connect with the tramways of the Wigan and Bolton Corporations and the South Lancashire Tramways Co. The Dawsbury, Batley and Birstal Tramways Bill will mean the reconstruction for electric traction of tramways in that district, and similar power is given to the South Staffordshire Tramway Co. with regard to the tramways now owned by them. The Wakefield and District Tramways Co. had their Bill rejected. In the case of the Harrow Road and Paddington Tramways, the company asked for power to electrify the tramways on the overhead trolley system. The London County Council, who will ultimately be the purchasing authority, sought to have a voice in saying what system of traction should be adopted, but the Committee decided to allow the Bill to proceed.

The electric lighting legislation was nearly all contained in the Electric Lighting Confirmation Orders, of which there were seven, containing in all confirmation of Board of Trade orders in respect of 53 districts. In the main they were unopposed, but fights took place over the Warmley and Walton-on-Thames orders, and in each case the Committee inserted a modification of the Bermondsey clause. In the case of private Bills, the Blackheath and Greenwich District Electric Lighting Co. takes power to absorb the Lewisham and District Electric Supply Corporation, and the Chard Corporation gets power to supply electricity. The Newcastle Electric Supply Co. are authorised to take over the electricity undertaking of the Walker and Wallsend Gas Co., which was the first gas company ever to get power to supply electricity. The Electric Supply Bill of the London County Council was dropped. The Dover Corpora-

tion has obtained power to acquire the undertaking of the Dover Electricity Supply Co. The Willesden Urban District Council tried to get powers to supply electricity in adjacent districts but failed, and, in addition, had the Bermondsey clause inserted in their Bill. Parliament seems steadily to set its face against the attempt of local authorities to supply electrical fittings, and struck such power out of the South Shields Bill and inserted a clause in the Sheffield Corporation Bill at the instance of the Electrical Trades Association. The clause in the L.C.C. General Powers Bill to empower the Metropolitan Borough Councils to supply electrical fittings was dropped.

Taking the whole work of the session, it will be seen that while there has been little of the prolonged fighting which took place on the introduction of the first power Bills and on the question of electrolysis, yet a great many Bills have been passed which, if brought to completion, will find employment for a vast amount of capital and work for a large army of workmen.

INTERNATIONAL FIRE PREVENTION CONGRESS.

NECESSARY PRACTICAL SAFEGUARDS AGAINST FIRES CAUSED BY LIGHTNING.

By Alfred Hands, F.R.Met.S.

(*Abstract.*)

The number of buildings damaged by lightning in this country varies slightly from one year to another, but is so far constant that it is perfectly safe to say that in the course of any ten years between 3,000 and 4,000 suffer from this cause, of which about 200 are churches.

Statistics that have been published show that thunderstorms are gradually increasing over the whole of civilised Europe. Thus, in the course of sixty years the average number of such storms in London has increased from 12 to 22 per annum. The use of lightning conductors, though not always successful, has no doubt reduced the amount of damage which would otherwise occur. They sometimes fail when they have been applied in accordance with well-known rules, and on the other hand cases occur in which conductors that would be condemned as inefficient under those same rules answer perfectly when struck by lightning. This anomalous state of affairs shows that there is some important factor that is very frequently overlooked, and which must be the crux of the question.

Probably one of the causes that interfere with a clear conception of the methods necessary for protection is the view that is often taken as to what a discharge of lightning is. Although the idea of a thunderbolt accompanying a lightning flash is known by scientists, and probably by the majority of the public, to be illusory, there is still a tendency to regard lightning as something which leaves a cloud and damages a building or other object by striking it. The language used in connection with the subject unfortunately fosters this idea. Even the term "struck by lightning" is scarcely correct.

At the best lightning is too often regarded as an electric current overcoming the resistance of the air; but this resistance has nothing in common with that which is the subject of Ohm's law, and to consider it merely as a momentary current is apt to give a somewhat misleading view of the matter. It should be regarded as a breakdown of the dielectric, as a fracture or cracking, both of the air and of any other resisting medium between the oppositely charged bodies, the clouds and the earth. We may, in fact, regard ourselves as living between the inner and outer coatings of an enormous Leyden jar or other condenser.

Now when the stress to which the air is subjected has reached the breaking point, which is about half a gramme weight per square centimetre, the line of the fracture becomes visible by the intense heat making the air particles momentarily incandescent, and this we call "lightning." The building which, being in the line of the strain, gets damaged forms only a part of the fracture; the air is equally damaged, but is a self-repairing medium. Unfortunately, our buildings, trees, and bodies, which are less resisting than the air, are not self-repairing, and so we get the deplorable losses of life and property that occur every year.

A building offers less resistance—in other words, it is weaker—than the surrounding air, therefore the breakdown would tend to go through a building rather than pass it by and go through the air beside it, even if there were no metals in it to render it still more weak. There would be a line of conduction, or infinitely weak line, through which the fracture would take place instead of through the structure, and even allowing for the effects of induction, lightning can no more be said to be attracted by a conductor than a crack across a sheet of glass can be said to be attracted by any weak part which would cause it to take other than a straight course. At the top the conductor would be provided with a point, or several points, so as to prevent the discharge occurring, if possible; and, if not, to try and render it less violent. As regards the lower part, if it ended at the ground line, the conductor would answer provided there had been rain, and the surface of the ground was wet; but if the flash occurred in dry weather, there would be resistance to overcome between the conductor and the conducting stratum below, causing heat, and the least that would happen would be that the ground at this point would be blown up. It might be considered not worth the expense of making a good earth connection to prevent this; but one cannot be certain that this would be the only effect. The explosive force in such a case is often equal to that of some pounds of gunpowder, and so there is danger of damage to the brickwork or foundations. A fairly good earth connection is therefore advisable, but it need not be a "perfect earth"; so long as the resistance is fairly low, and the conductor is of such a size as not to be fused, we can feel confident that it will answer in this case.

It must not be supposed that a good "earth" is never necessary; in very many cases it most certainly is, but a good "earth" is a matter of comparison. One cannot fix a limit of so many ohms, and say beyond that a conductor "earth" is inefficient, for under certain conditions a conductor would not fail with an "earth" resistance of 100 ohms, or even hundreds of ohms, while under others 2 or 3 ohms would be too much. A discharge would not leave a conductor even if there were a fairly high resistance, to go to earth by another route unless there were a rival one open to it. By a good "earth" is meant one that has a low resistance in comparison with any other possible "earth" in its neighbourhood.

In the case of a structure composed of a solid mass of bricks or stone, with a stone staircase in the interior and a gas pipe carried up to afford light at intervals, there would be a rival conductor in the interior with a perfect earth connection; for gas pipes, owing to the extent of the surface of the mains underground, have merely nominal "earth" resistances, and, if the conductor had a higher one, the discharge would either be entirely diverted to the gas pipe or be divided between the conductor proper on the exterior and the accidental one in the interior, according as the resistance of the former was great or small. It is not practicable to make the "earth" of the intended conductor appreciably lower than the gas main, but if we succeeded in getting it so to a fractional extent, there would still be the dangerous rival inside, and there would be a side flash, or let us say a side fracture, between the two conductors, if the brickwork or air between, as the case might be, was not sufficiently strong to resist the stress suddenly thrown upon it. It would be necessary then, besides having a perfect "earth," to place the conductor so that there should be a sufficiently strong buffer of resisting material between the two as to make it impossible for the discharge to break through. I do not mean by this the use of glass insulators or keeping the conductor a few inches away from the wall, but a considerable space of resisting material.

It is necessary to recognise that side flash, or sparking, will occur between a struck conductor and other metals sufficiently near it. A perfect "earth" does not prevent side flash, it only reduces the sparking distance; a comparatively bad "earth" increases it. We must therefore see that the other metals are at a safe distance, or make connections across to act as a conductor for the spark. The safe distance between two perfectly "earthed" conductors, in the most extreme cases, should be 5 ft. for ordinary building materials, while in some cases, depending on the course of the accidental conductor, it is considerably less.

Unfortunately, metals are introduced so largely into the construction of modern buildings that it is not surprising, with conductors placed indiscriminately, that cases of failure occur.

On an average about a dozen cases of failure of conductors occur in this country every year, and they may be divided into five main classes or headings:—

1. Where the conductor is not touched, the discharge taking an entirely different course. Such cases are not very interesting, and ought scarcely to be called failures of conductors—they are merely failures of the sanguine expectations of those who put them up.

2. Cases in which the conductor is struck and damage occurs owing to non-compliance with the more elementary rules appertaining to the subject. Such cases are not very serious as a rule. The ground may be blown up owing to a very high resistance; the conductor may be broken or fused at a bad joint, or it may be torn loose owing to a bad bend.

3. Cases where a part or the whole of the discharge leaves the conductor and takes another course through accidental conductors to earth. Such cases are primarily due to there being alternative paths available for the discharge, and they often result in very serious damage. If inflammable materials happen to lie in the path, the risk of destruction of the building by fire is very great. The most dangerous form of alternative path is a gas pipe, and soft metal pipes are especially so.

4. Where sparks occur between lightning conductors and neighbouring metals not leading to earth. These cases do not usually result in very serious damage, unless fire is caused by something inflammable in the line of the spark.

5. Where there is no side flash from the conductor, but sparks occur between two metals distinct from the conductor. These cases are very interesting, but fortunately are not very common. They are apt to cause fires; in fact, it is often the setting of the building on fire that shows that such an effect has occurred.

In explaining several cases of buildings which had suffered through lightning, the author mentioned a case of a church where it was reported that lightning had struck through the west window of the nave, being "attracted" by the organ pipes. The facts were that the vane was struck, and the discharge passed down the conductor; but by a curious combination of metals the weakest path was formed by accidental conductors, consisting of lead flashing round the tower, a rainfall pipe, an outside gas bracket and the pipe supplying it, so that the discharge passed by these through the gas meter, exploding it, and setting fire to a wood staircase under the organ.

In another case the discharge was said to have struck the nave roof under the spire. Here the spire was covered with copper, and had a copper tape conductor carried over it in addition; but there

were two alternative paths, one a rainfall pipe from the tower, and the other the lead flashing on the nave roof connected with the rain-water gutter and down pipe. The discharge divided between the conductor and the fall pipe from the tower; but there was a weak spot between this fall pipe and the lead flashing, and so a fracture occurred through the parapet wall. All that was wanted in this case was a connection of metal across this weak spot, and this damage would not have occurred.

In a further case of a church on which a copper tape conductor, with earth plate, had been fixed, only a few months afterwards it was struck by lightning, side flash occurring through the wall to a water supply pipe. In this case the "earth" resistance was too high, although there was an earth plate.

The author cited other cases which occur, such as a hooped chimney shaft, a metal steam-pipe carried up inside a shaft, and a case of an alternative path provided by a vane on a tower, with connecting rods passing down to an indicating dial in the hall, in proximity to other ironwork. In such a case, the author pointed out that anyone standing sufficiently near at a time when the vane was struck would accidentally complete the conductor chain.

A fact which, although well known to electricians, is frequently overlooked, is, that *all* metals are conductors, the difference in conductivity between one kind of metal and another being in this connection a factor of very little moment; also that the accidental conductors about a building require just as careful consideration as the intended conductors, and in some cases even more.

True protection from lightning often consists of a good deal more than the mere erection of conductors. The part that often makes the difference between efficiency and non-efficiency is the making of various connections to bridge over what the author calls sparking gaps, as well as keeping a safe distance away from metals that it would be dangerous to connect to.

The places where connections must be made are where there would be great differences of potential. A spark is, of course, the outward and visible sign of a difference of potential. If this difference is not sufficiently great for the spark to bridge the gap between the two metals, no effect will occur.

It is said that side flash is due to self-induction, but this is of small moment. It exists, of course; a conductor cannot take a sudden discharge like a flash of lightning without there being enormous self-induction; but for this very reason it may, for practical purposes, be disregarded. As it cannot be entirely done away with, it is difficult to say what would be the practical effect of a lightning conductor absolutely without self-induction.

Experiment shows that by increasing the self-induction one increases the sparking distance, and conversely, that by reducing it, one reduces the length of the spark. The author alleges that the way to reduce the self-induction in a lightning conductor to a minimum would be to give it a number of sharp bends, that is, to run it backwards and forwards across the face of a building instead of direct down to earth, but he does not suppose that anyone would seriously recommend such a method of procedure as conducive to efficiency, and looking at the matter from a practical point of view, if one were to erect a lightning conductor in the centre of a field, with absolutely no other metals near it, there would still be self-induction, but there would be no side flash. Self-induction with no other metal near is of no moment; self-induction with other metals near, is; there the point of practical interest centres in the "other metal," and not in self-induction.

Cases in which sparks occur between two metals quite distinct from the conductor have been referred to, and such effects are far more common than might be supposed; many mysterious fires, many so-called extraordinary freaks of lightning, may be explained by them.

At the moment of a lightning discharge, the effect cannot begin and end just at the one spot struck; there must be waves of potential set in motion, and the effect would be visible as a spark at places where one metal approached another, provided they happened to be set in just the right manner. These effects may cause fires if the conditions are suitable, and they therefore require guarding against by connections at the critical points.

There is one way in which protection can be secured without the tedium of mastering the subject. If one were to cover a building completely with metal from the top of the chimneys down to the ground line, making earth connections on each side, one would have a sort of metal case, inside which no electrical effects would occur. One might run a large number of wires over it, both vertically and horizontally, but the meshes formed by the wires would require to be comparatively small. It would not be sufficient to run just a few conductors over it, and so get a sort of skeleton cage. There is a case on record which shows that this does not afford metallic screening.

For very dangerous places, such as explosives magazines and factories, metallic screening is generally the best, and often the only safe course to adopt.

For general purposes, however, the course to be adopted is an intelligent consideration of the conditions that may exist in the structure to be protected. Knowing the conditions and their effect, connections must be made between the lightning conductor and any metals so near to it that they would constitute weak spots where side flash would occur, and even between those metals and others, or between two independent metals, if they were so placed as to cause sparking.

In arranging a conductor system it must be borne in mind that there are certain parts of a building that are exposed to be struck, and therefore the system must comprise lines of conduction from all those parts. To protect one and leave another exposed is waste of money.

Earth connections are important, and it is necessary to get the lowest resistance of any possible "earths." This may be obtained by means of earth plates, or connections to gas and water mains, or by both, but in making these connections caution is necessary. Earth plates should be proportionate to the moisture in the soil, never less than 3 ft. square, or an equivalent area, in a wet situation, while in drier ones the plates must be increased in area proportionately. In somewhat dry soils resistance may be reduced by bedding the earth plates in coke, but coke should not be used unless it is absolutely necessary.

As regards the best kind of conductor to use, taking into consideration durability and cheapness, copper is the most suitable metal, and as regards form, copper tape, band or ribbon, as it is indiscriminately called, is the best for similar reasons.

THE ELECTRIC AUTOMOBILE AS AN INCOME PRODUCER FOR CENTRAL STATIONS.*

The advent of the automobile has been so recent that its progress and possibilities seem to have, as far as the Pacific Coast is concerned, entirely escaped the notice of central station managers. And yet I have no hesitation in saying that within a very few years most of the commercial and also the passenger transportation now carried on by horse traction will be carried on by automobiles in preference. In this event, it will be readily seen how large an income factor automobiles will prove in the future. The profit to the central station from any specified service depends upon three conditions, namely:—

1. Quantity of current consumed.
2. The time at which the current will be required.
3. The character of the load.

With regard to the first point, viz., the quantity of current required. A light electric runabout will consume not less than 15 amperes on the four-hour rating, and will run about 40 miles on one charge. A 5,000-lb. truck will require a battery capacity of 50 amperes on the same rating; the mileage per charge at the present time is between 25 and 35 miles.

There is certainly no city or town so small that it does not use at least 50 vehicles of some sort; and to say that 50 per cent. could be replaced by automobiles is making a conservative estimate. These vehicles could comprise buggies, farm wagons, tradesmen's carts, delivery wagons, ambulances and express, freight or passenger wagons.

Allowing a daily average of 20 amperes at 125 volts for these vehicles on a 4-hour charge, would mean an output of 250,000 watts, which, at 4 cents per kilowatt, represents an income of $10.00 per day.

As the charging of batteries of electric vehicles follows the standard rules for charging stationary batteries, the charge generally could be tapered off and spread over seven or eight hours. This length of charge, although necessary to obtain a full mileage, is by no means essential, as half charges can be put in in a couple of hours without injury to the battery.

With regard to the second point—the time at which the current will be required—the conditions of service of automobiles will permit of their being charged at periods of light central station load when the station has plenty of power, which central station managers are unable to use; and except on emergencies, there will be seldom any reason to charge many automobiles between the hours of 5 and 10 o'clock at night. The load conditions, therefore, are what the central station manager is trying his best to obtain, and represent a factor of almost clear profit, especially when the station is operated by a water power transmission plant with free water.

The third point, viz, the character of the load. The character of the load is absolutely ideal, being a perfectly regular and steady storage battery load without fluctuations. It has the further advantage of steadying the day voltage, the irregularity of which frequently gives serious fluctuations in the lighting load in consequence of the power factor being so greatly in excess of the lighting factor.

Regarding the expense of operating automobiles, an impression prevails that automobiles are an expensive luxury, and while this has been so in the past, it has been because machines have been put on the market quite inadequate to the work they were called upon to perform.

There is no more reason for automobiles to break down than for horses and carriages. On the other hand, there is far less reason, and the cost of operation per mile of travel should be less. The speed is greater than that of the horse, the distance far in excess, the reliability and convenience far greater.

The automobile is unaffected by the heat of summer or the cold of winter, may be urged to its limit up hill and with safety driven fast down hill; in fact, there is no service that the horse is at present performing that cannot be better done, even in the present early stage of the industry, by an automobile.

There is also a widespread impression that an electric automobile is incapable of a greater speed than 10 or 12 miles per hour. This is entirely erroneous, as there is no more limit to the speed of this machine than to that of one operated by steam or gasoline, the speed being simply a question of power and gearing.

Very few high speed electric automobiles are at the present time on the market, simply because the manufacturers are so busy trying

* A paper presented by A. E. B. Ridley to the Seventh Annual Convention of the Pacific Coast Electric Transmission Association, June 16-17, 1903.

to keep up with the demand for their present standard types that they have no time to bring out new designs.

Up to the present time I know of no central station manager who has given this matter any serious consideration or made any attempt to assist in the development of the industry; but I feel assured that if the companies would instal motor converters and operate wagons of their own, their example would be followed by many who are now deterred by the inability to secure direct current suitable for charging their machines.

Several automobiles are now being used as service wagons by the superintendents of the electric light plants in the Eastern cities, and they are giving entire satisfaction. There is no reason why the success of an electric automobile in the East for carriage, hack, delivery wagon and truck service should not be repeated here.

The sooner the central station managers investigate this matter seriously, the sooner they will obtain a valuable source of income, besides conferring a benefit in advancing a new and growing industry.

THE CONTINENTAL ELECTRICAL ENGINEERING INDUSTRY.

The Competition for the Brussels Contract.

The invitation which the municipal authorities of Brussels recently issued for the submission of tenders for the equipment of a new central station in that city does not appear to have induced any British firms to compete for the contract, if one may judge from the list of offers which has been published, this being perhaps due to the experience gained in the past. However that may be, the competition proves to have been of an international character. The tenders, which range from as low as £130,000 to as high as £212,000, have been presented by the Société d'Electricité et Hydraulique, of Charleroi, the Société Internationale d'Electricité, of Liège, the Siemens-Schuckert Works Co., Lahmeyer & Co, the Helios Co., the Swiss Oerlikon Engineering Co., Rothenhaels & Co., of Berne, and the General Electricity Co., of Berlin, in conjunction with the Union Electricity Co. of the same city. It is said that the scheme of the latter combination is recommended for acceptance.

The condition of the German electrical engineering industry at the present time is reported to be comparatively good, all the works being said to be abundantly provided with orders, and prices being somewhat higher. If this statement is really a correct representation of the actual situation of affairs, it is difficult to understand why all the principal companies should be so eager to secure the Brussels contract.

The names of the Lahmeyer Co. and the Felten & Guilleaume Co. are being coupled together in regard to a proposed understanding whereby the former would procure all its cables from the latter in the future. An arrangement of this kind formerly existed between the Schuckert Co. and the Mulheim cable works, but it terminated with the fusion of the former with the Siemens and Halske Co.

Herr Rathenau, general director of the A.E.G., of Berlin, is about to pay a visit to the United States where, among other matters, he will resume relations with the representatives of the principal American companies, who recently sojourned in the German capital. The community of interests between the A.E.G. and the Union Co., which represents the Thomson-Houston interests in Germany and certain other European countries, has naturally brought the former into closer connection with the American business.

German Companies.

The accounts of the Schuckert Electricity Co. for the year ended March 31st, 1903, are of special interest, inasmuch as they are the last which will be issued in relation to this company as an independent undertaking as a result of the recent amalgamation with the heavy electrical engineering departments of the Siemens and Halske Co. under the title of the Siemens-Schuckert Works Co. It will be remembered that the Nuremberg Co., which distributed a dividend at the rate of 14 per cent. on a capital of £1,125,000 in 1897-98, 15 per cent. on £1,400,000 in 1898-99, and 15 per cent. on £2,100,000 in 1899-1900, decided to abandon the contemplated payment of 10 per cent. in the following year mainly on account of the collapse of the Leipsic bank and the consequential necessity for at once paying in cash the sum of £210,000 as the purchase price of the shares which the directors had agreed to take up in the Jaice electrical works. The year 1901-02 terminated with a loss of nearly £770,000, owing to the heavy depreciation of securities and provision for guaranteed risks, this sum being covered by drawing upon the reserve fund, which was thereby reduced to £65,600. The accounts for 1902-03 now show gross profits on manufacturing to the extent of £214,341, as compared with £193,936 in the previous year, and after meeting the cost of administration, interest charges and depreciation, there remains a net profit of £6,677, of which £333 is transferred to the reserve fund, and the balance carried forward to the next account. The directors' report refers to the improvement in business since the amalgamation with the Siemens and Halske Co., and then deals with the foreign branches. In this connection it is suggested that an understanding will be arrived at with the external branches, and the hope is expressed that the company's English interests (the British Schuckert Co.), may be associated with the English interests of the Siemens & Halske Co.

The Continental Company for Electrical Enterprises, of Nuremburg, is the financial trust of the Schuckert Co., which holds out of the former's total share capital of £1,600,000, no less than £1,441,000, which recently stood in the books at one-half the nominal value. At a recent meeting of the directors of the Continental Co., the balance-sheet was submitted for the year 1902-03, this showing little variation in the position of affairs as compared with the previous year. The profits from the undertakings in which the company is interested, and from interest on securities amount to £112,786, as against £108,850 in 1901-02. Administrative expenses and taxes absorb £19,234, interest and bank charges £71,190, and interest on loans £20,000, and after making provision for losses on securities and redemption of capital, the final result is a loss of £21,007, as against a loss of £59,937 in the preceding year. By absorbing the reserve fund, the deficit for 1901-2 was reduced to £37,959, and the loss for the past year thus increases the deficiency to £58,966.

The directors of Lahmeyer & Co., of Frankfort-on-the-Maine, which distributed a dividend at the rate of 10 per cent. for 1900-1901, and incurred a loss of over £120,000 in the following year, have issued a statement that is far from being of an encouraging character, for the year ended March 31st, 1903. It shows gross profits amounting to £115,211, as compared with £113,522 in the preceding year. After deducting interest on bonds, general expenses, the expenses taken over from the German Co. for Electrical Enterprises, and providing for depreciation of plant at the works, the statement indicates a loss of £18,584, which is covered by the disposal fund of £250,000 which was obtained by the company's amalgamation with its trust, the German Co. for Electrical Enterprises. The directors attribute this new loss partly to the decline in sale prices, which were considerably lower at the end of the financial year than at the beginning, and partly to the insufficiency of employment for the works during the second half of the year. It appears that the disposal fund has now been reduced from the original sum of £250,000 to £125,000 by writing off the expenses incidental to the fusion with the German company and by the depreciation of securities held by the latter, and by a loss of £15,000 on the Russian business, mainly owing to the dissolution of the branches at St. Petersburg and Moscow. The statement concludes by remarking that the new financial year has opened with greater activity at the works, although an upward movement in prices has not yet taken place, and that the undertakings taken over from the company's trust are in a satisfactory state of development.

The report of Brown, Boveri & Co., of Mannheim, which is a subsidiary of the parent undertaking of the same title at Baden, states that, notwithstanding the diminution in the number of workmen employed, as mentioned in the previous year, it has been possible to obtain results almost equally as favourable, owing to the adoption of extreme economy and the profits realised on several large orders. With a nominal share capital of £300,000, of which one-half is paid up, the company has earned net profits of £6,040 for 1902—3 as compared with £6,263 in the preceding period, and a dividend is proposed to be paid at the rate of 4 per cent., as in the previous 12 months. In addition to the supply of large generators for electric lighting and power stations, the report mentions the considerable activity displayed by the company in introducing steam turbines on the Brown, Boveri-Parsons system, and for very high powers. Apart from central stations, turbines of 5,500 H.P. have been delivered for the Henkel-Donnersmark ironworks, 1,100 H.P. for the Hosch steelworks of Dortmund, 2,000 H.P. for the Rothe Erde ironworks, 1,200 H.P. for the Dahlbusch works, and 10,000 H.P. for the Rhenish Westphalian works at Essen. These turbines have been constructed at Baden, but as a result of the reception by the Turbinia (German Parsons) Co. of orders for two turbines of 6,000 H.P. and 10,000 H.P., the company proposes to commence the building of these engines in Germany, thus necessitating a considerable extension of the workshops. As to the future outlook, the report states that unfavourable conditions still prevail in the electrical industry, and that some firms accept orders even at prices which result in a loss. A continuous improvement cannot be expected to take place in the near future, although the company is now fully employed.

The Company for Wireless Telegraphy, of Berlin, which has taken over the rival systems of Braun-Siemens and Slaby-Arco, and thus terminated the competition which had arisen between the owners of these methods in Germany, has now adopted the name of "Telefunken" as the registered name for spark telegraphy. It is stated that the company has supplied several portable field installations for the United States army, and that the trials have shown the faultless transmission of telegrams overland for a distance exceeding 62 miles. This is considered to be an excellent result, in view of the difficulties of transmission overland, and the smallness and lightness of the installation wagons. In addition to the portable plant, the company has delivered apparatus for 20 stations for the United States navy, where they are being tried in several places already occupied by the Marconi company. The German company is also reported to have received orders for two sets of apparatus for the Norwegian Telegraph Administration, which proposes to test them for the purpose of affording communication with the fiords. In these cases the distance only ranges from 20 to 30 miles.

Swiss and Russian Enterprises.

The report of Brown, Boveri & Co., of Baden, which has made its appearance simultaneously with that of the company's German subsidiary, shows that the position of the Swiss undertaking has slightly improved during the year 1902-3. After being successful in distributing 16 per cent. two years ago, the profits considerably declined in 1901-2, when the dividend was reduced to 5 per cent. A recovery has, however, now taken place for the past year, the net profits amounting to £41,718 as against £29,046, and it is proposed to make a distribution at the rate of 7 per cent. on the share capital of £500,000. The report states that the improved results are mainly due to the greater attention paid to cheapening the cost of production, and although prices were depressed the company succeeded in

obtaining better rates for large orders than its competitors. Nevertheless, the manufacturing results were prejudicially affected by losses incurred in connection with customers, this apparently referring to payments made under guarantee risks. The report refers to the progress made in the construction of steam turbines, of which 38 of a total of 30,065 H.P. have been delivered, and 30 of 33,000 H.P. are on order. The new financial year has been entered upon with an abundance of orders which will fully occupy the works for the 12 months.

The Russian General Electricity Co., of St. Petersburg, which was formed in 1902 to continue the branch of the Berlin General Electricity Co. in the Russian capital, has completed its first year's trading with a net profit of 11,345 roubles, which has partly been devoted to depreciation and partly carried forward. At the end of 1902 only 40 per cent. of the share capital of 1,000,000 roubles had been called, although since then the full amount has been paid up. The company does not manufacture in Russia, but serves solely as the sales bureau of the A.E.G. in Berlin.

The Russian (Tudor) Accumulator Co., of St. Petersburg, has realised net profits amounting to 56,590 roubles for 1902. It is intended to pay a dividend at the rate of 6 per cent., as compared with nil in 1901, and 3 per cent. in 1900.

The St Petersburg Company for Electrical Enterprises, which is closely associated with the Helios Electrical Co., of Cologne, has not yet developed in the favourable manner that was anticipated. Although the company's gross receipts were higher during 1902 than in the previous year, the net revenue was less, and it has been impossible to propose any dividend as was the case in 1901.

The Italian branches of the Siemens & Halske Co., and the Schuckert Co., have now been formed into a company under the title of the Societa Italiana d'Elettricita Siemens-Halske e Schuckert, with a capital of £40,000. This amalgamation is, of course, one of the results of the fusion of the two parent companies in Germany.

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

16,965. "Improvements in electrical fire alarm apparatus." J. P. Robertson. August 4th. (Complete.)

16,975. "Improvements in electrical cut-outs." H. Korten. August 4th.

16,988. "Improvements in or relating to partitions or diaphragms for electrolytic and electro-plating purposes." P. Steenlet. August 4th. (Complete.)

16,992. "Improvements relating to electrolytic cells. P. A. Gaye. August 4th.

17,001. "Automatic electric stopping apparatus for lace and net machines." B. J. B. Mills. (A. Pocheron and F. Cellery, France.) August 4th.

17,059. "Improvements in incandescent filaments for electric incandescent lamps." W. P. Thompson. (Bayerische Glühfädenfabrik Augsburg-Lechausen Georg Luedecke & Co., Germany.) August 5th.

17,069. "Improvements in geometric telegraphs." G. B. Rossman. (Complete.)

17,072. "A method of syntonising two electric circuits and apparatus for use therein." C. R. Payne. August 5th. (Complete.)

17,073. "Improvements in electric arc lamps." T. Hamilton-Adams. August 5th.

17,082. "Improvements in the manufacture of trolley poles and means for connecting them to trolley standards in trolleys used for electric tramcars or vehicles propelled by electric traction." E. M. Munro, H. Brecknell and H. I. Rogers. August 6th.

17,105. "Improvements relating to insulating supports for use in electric traction systems." D. Bordon. August 6th.

17,118. "Improvements in moulds for making matrices for the production of cylindrical type wheel casings, type segments, or the like by electrotype." W. P. Thompson. (The firm of A. Greeff & Co., Germany.) August 6th. (Complete.)

17,128. "Improvements in means for electric signalling between railway trains, and between railway stations and trains." M. Archambault. August 6th.

17,140. "Improvements in electro-magnets." F. de Mabe. August 6th.

17,149. "Improvements in electric traction on a shallow conduit system." S. G. Bennett. August 7th.

17,150. "Improvements in or connected with switches for starting electric motors." A. Sykes. August 7th.

17,173. "Improvements in electrical starting gates for race-courses." H. F. Foster. August 7th.

17,179. "Improvements relating to electric railway systems." H. H. Lake. (Morgan Electric Machine Co., United States.) August 7th. (Complete.)

17,184. "Improvements in clamps for wires, especially applicable for use in overhead electric conductors." F. Kruckl. August 7th. (Complete.)

17,195. "Improvements in and relating to wireless telegraphy." O. Rochefort and E. Mors. August 7th.

17,207. "Improvements in or connected with dynamo-electric machines." T. M. Dutton and The Sandycroft Foundry Co., Ltd. August 7th.

17,214. "Improvements in protecting devices for electric circuits." W. B. Woodhouse. August 7th.

17,225. "Improved interlocking automatic inter-communication telephone switchboard." F. J. Lowe. August 8th.

17,229. "An improved appliance for gripping and supporting the wires of overhead wire systems of electric traction." J. H. Luby and W. Harris. August 8th.

17,232. "Improvements in terminal holders for electric wires, leads or cables." C. H. Stevens. August 8th.

17,241. "Device for re-railing electric or steam tramcars which have accidentally left the lines." J. W. Harrop, T. Dickinson and H. Dickinson. August 8th.

17,245. "Improvements in electric light fixtures." E. A. Carolan. (The General Electric Co., United States.) August 8th.

17,247. "Improvements in electric light fixtures." E. A. Carolan. (The General Electric Co., United States.) August 8th.

17,248. "Improvements in electric rheostats." E. A. Carolan. (The General Electric Co., United States.) August 8th.

17,249. "Improvements in reels for electric cables and the like." E. A. Carolan. (The General Electric Co., United States.) August 8th.

17,272. "A new and improved device for electrically firing blasting cartridges and the like." T. Grainger. August 8th.

PUBLISHED SPECIFICATIONS, 1902.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

4,274. "Improvements in or relating to electric cells or batteries." H. H. Lake. (Soc. Anon. "Le Carbone.") Dated February 19th.

4,285. "Improvements in sockets for incandescent electric lamps." A. E. Ellen. (Yost Miller Co.) Dated February 19th.

4,357. "An improvement in flexible electric conductors." Siemens Bros. and Co. and W. Dieselhorst. Dated February 20th.

4,374. "Improvements in or relating to electric arc lamps." J. A. Rignon and E. Eisenmann. Dated February 20th.

4,445. "An improved automatic telephone system." E. A. Faller. (Date applied for under Patents Act, 1901. August 22nd, 1901.) Dated February 21st.

5,831. "Improvements in apparatus for regulating electric currents." R. C. Clinker. Dated March 10th.

8,112. "Improvements in electrical indicating and controlling mechanism." Hon. R. T. D. Brougham. Dated April 4th.

8,748. "Improved means for securing and adjusting the active laminated rings of electrical machines and motors in their frames." Siemens Bros. & Co., Ltd. (Siemens & Halske Aktiengesellschaft.) Dated April 7th.

8,858. "A process and device for producing effective and reliable electrical ignitions of explosive substances." H. W. Hellmann. Dated April 16th.

9,040. "Improvements in and relating to the manufacture of electric conductors." S. G. Brown. Dated April 18th.

9,111. "Improvements in electro-magnetic clutches and variable gear." P. W. Northey and Electric Motive Power Co., Ltd. Dated April 19th.

9,135. "Improvements in coin-freed electric meters." British Thomson-Houston Co., Ltd., and F. Holden. Dated April 19th.

9,150. "Improvements in clock-controlled mechanism for turning on gas, electric current, water, and the like, at pre-determined times." S. W. North. Dated April 21st.

9,231. "Apparatus for counting telephonic conversations." J. H. Meyer. Dated April 21st.

9,315. "Improvements in electric controllers." C. T. J. Oppermann. Dated April 22nd.

9,441. "Improvements in electromagnetic traction for railways and the like." H. H. Lake. (A. Pacinotti). Dated April 23rd.

9,529. "Improvements in terminals and binding screws for electric batteries and connections." W. R. Edwards. Dated April 24th.

9,803. "Improvements in and relating to the electrolytic decomposition of alkaline salts." M. Wildermann. Dated April 28th.

10,231. "Improvements in and relating to high-speed electrical generators and motors." S. Z. de Ferranti. Dated May 3rd.

10,800. "Improvements in electrostatic measuring and indicating instruments." S. Z. de Ferranti. Dated May 10th.

10,841. "An improved form of insulator for electric fittings." C. T. A. Henshaw. Dated May 12th.

11,068. "Improvements in apparatus for actuating the electrical controlling appliances of the motors of electric railway motor cars." Siemens Bros. & Co., Ltd. (Siemens and Halske Aktiengesellschaft.) Dated May 14th.

11,139. "Improvements in or relating to the electrical igniters of gas and similar explosive vapour motors." A. R. Bellamy. Dated May 15th.

11,395. "Improvements in or applicable to rheostat switches for controlling electric currents." W. R. Laidlaw and G. H. Scholes. Dated May 17th.

11,404. "Improvements in electric fuses." O. L. Peard. Dated May 17th.

11,516. "Improvements in apparatus for electrically operating tools." H. J. Haddan. (J. S. Andrews and W. M. Simpson). Dated May 20th.

11,825. "Improvements in electric transformers." H. H. Lake. (General Electric Co.) Dated May 24th.

11,838. "Improvements relating to controllers for electric motors." H. H. Lake. (General Electric Co.) Dated May 24th.

11,839. "Improvements in or relating to controlling devices for electric arcs." H. H. Lake. (General Electric Co.) Dated May 24th.

11,849. "Improvements in devices for controlling motors from a distance." H. H. Lake. (General Electric Co.) Dated May 24th.

11,850. "Improvements relating to volt ampere-meters or direct-current wattmeters." H. H. Lake. (General Electric Co.) Dated May 24th.

12,157. "An improvement in the manufacture of filaments or the like for electrical incandescence lamps." C. D. Abel. (Siemens & Halske, Aktiengesellschaft.) Dated May 28th.

12,160. "Improvements in the manufacture of filaments or the like for electrical incandescence lamps." C. D. Abel. (Siemens & Halske, Aktiengesellschaft.) Dated May 28th.

12,161. "Improvements in electrical incandescence lamps." C. D. Abel. (Siemens & Halske Aktiengesellschaft.) Dated May 28th.

13,154. "Improvements in and connected with electro-magnetic annunciators for telephonic or similar purposes." H. Oppenheimer. (Actiengesellschaft Mix & Genest.) Dated June 10th.

15,142. "Improvements in and relating to incandescent electric lamp-holders." A. Vandam and T. H. Marsh. Dated July 7th.

15,944. "Improvements in electrical brushes for dynamo-electric machines, electrical motors, and other electrical machines and apparatus where brushes for collecting an electrical current are or may be employed." The Tangye Tool and Electric Co., Ltd., and A. H. Bate. Dated July 17th.

16,852. "Improvements in perforators more particularly for use with automatic telegraph transmitters." J. Gell. Dated July 28th.

19,432. "Improved means for supporting electric lamps and shades." R. W. Braham. Dated September 4th.

22,180. "Improvements in electric ignition devices for gas burners." La Soc. Radiguet & Massiot. Dated October 11th.

23,357. "Electrically-driven surface planing and jointing machine for wood and the like." J. Barr and R. Anderson. Dated October 27th.

23,492. "Improvements in and relating to induction coils." J. O. Heinze. Dated October 28th.

24,100. "Improvements in and connected with electric brakes for railway and tramway vehicles." H. H. Lake. (General Electric Co.) Dated November 4th.

24,455. "Improvements in controlling devices for electric motors applicable to the motors of elevators and the like." Waygood & Otis, Ltd. (Otis Elevator Co.) Dated November 7th.

25,342. "Improvements in trolley poles and heads for electrically-propelled vehicles." T. C. Buder. Dated November 18th.

25,353. "Improved arrangement of the mercury in apparatus for the electrolytic decomposition of alkaline chlorides." C. Arzano. Dated November 18th.

25,354. "Improvements in the electrolytic treatment of liquids of all kinds." C. Arzano. Dated November 18th.

27,787. "Improvements in electric arc lamps." J. A. Heany. Dated December 6th.

28,102. "Improvements in or relating to coherers for use with etheric electrical apparatus." F. Schneider. Dated December 19th.

28,170. "Improvements in or relating to telephone systems." T. Stock. Dated December 20th.

28,171. "Improvements in or relating telephonic systems." T. Stock. Dated December 20th.

28,809. "Improvements in galvanic batteries." The Halsey Electric Generator Co., Ltd. (Halsey Electric Generator Co.) December 30th.